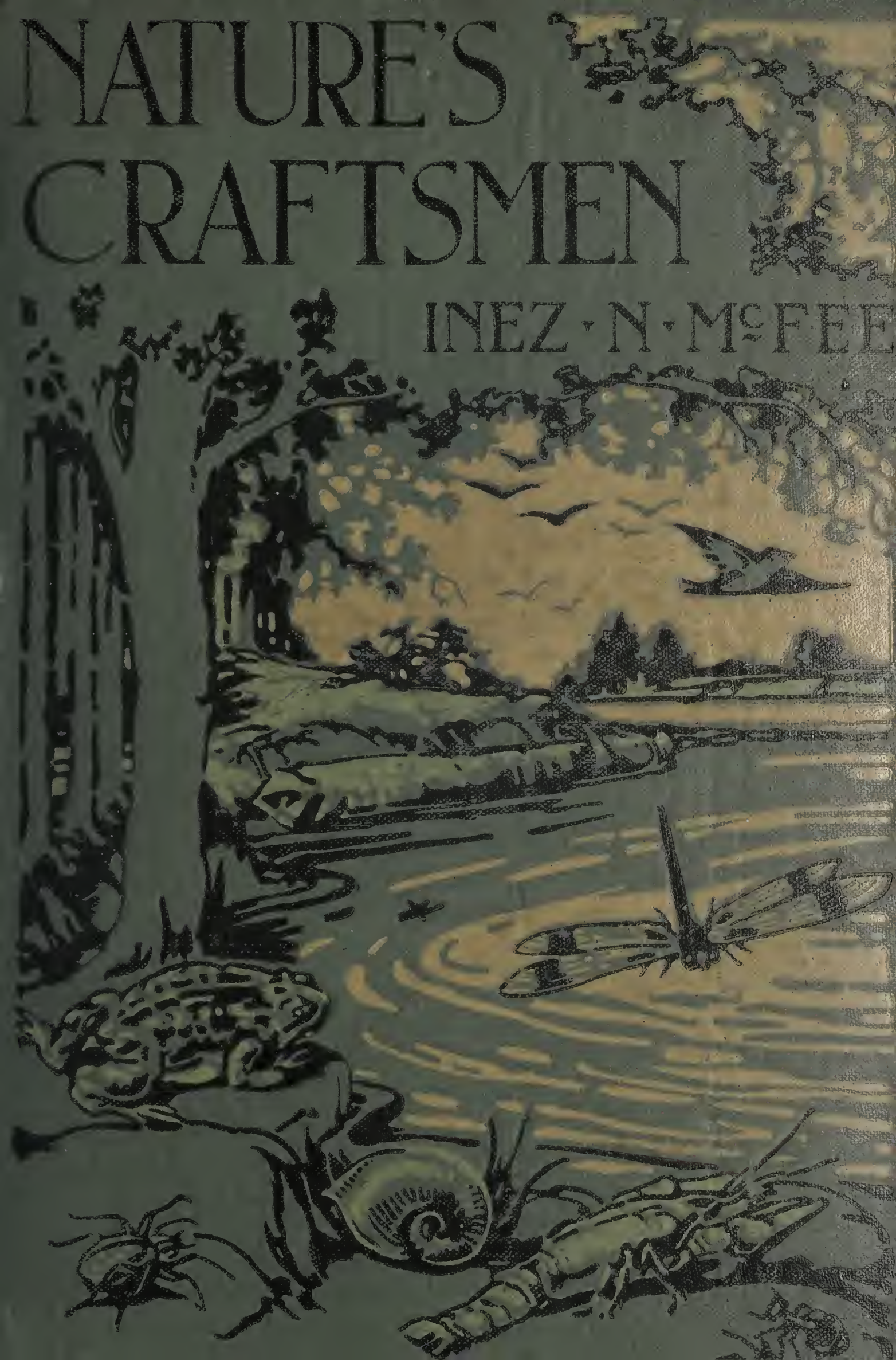
NATURE'S CRAFTSMEN

INEZ · N · McFEE



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NATURE'S CRAFTSMEN

BOOKS BY INEZ N. McFEE

NATURE'S CRAFTSMEN
SECRETS OF THE STARS
STORIES OF AMERICAN INVENTIONS
BOY HEROES IN FICTION
GIRL HEROINES IN FICTION
BOYS AND GIRLS OF MANY LANDS
LITTLE TALES OF COMMON THINGS
A PEEP AT THE FRONT
A TREASURY OF MYTHS
A TREASURY OF FLOWER STORIES

THOMAS Y. CROWELL CO., NEW YORK

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SILKWORMS

NATURE'S CRAFTSMEN

By

INEZ N. McFEE

Author of "Secrets of the Stars," "Little Tales of Common Things," "Boys and Girls of Many Lands," etc.

ILLUSTRATED

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PREFACE

THIS book, as its title implies, is an effort to make us human folks acquainted with some of Nature's humbler toilers—the builders, engineers, mechanics and professionals who do things quite as wonderful in their own way as the best that man can produce.

As we walk through garden, meadow, or woodland, we have constant opportunities to witness them at work, or behold the results of their labors; but too often we pass by with unseeing eyes. "Oh, it is only a spider's web, or an oriole's nest!" we say, and dismiss the subject from our minds. If we once could become really acquainted with the little craftsmen themselves—if we could draw the veil aside and see a fraction of the many marvels which Nature constantly has in store—how thrilled and humbled we would be!

This is precisely what the present volume endeavors to do in some measure. While addressed to young folks primarily, it is for every reader whose heart is still young and who rejoices in the open road. It brings together many a novel and interesting fact. The chapter headings alone will illustrate this fact: "A Race of Telegra-

phers," "Tiny Builders of a Great Nation," "Some Clever Weavers," "Rope Dancers," "Tunnel Builders," "An Insect Tailor," etc. Here we meet spiders that indulge in airship rides; ants that keep cattle; caterpillars that weave marvelous garments; silkworms that have made fortunes for their owners; and many another worker whose life story reads like the romance which it really is.

As we turn these pages we can but recall the exclamation of David, the Psalmist: "Great and marvelous are thy works, O God, and thy wonders past finding out!"

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Nature's Craftsmen

A RACE OF TELEGRAPHERS

"We human folks think ourselves very clever," observed Uncle John, evidently pursuing a train of thought suggested by the magazine he had just laid aside. "We talk about the magnificent buildings we have built, and the splendid machines we have devised to help our marvelous workmen turn out all sorts of triumphs. We think we have a corner on all the mechanical skill and inventive genius in the world. And yet, without half trying, I could name a score or more of little workers—mechanics and laborers of all sorts—who do things far more wonderful than man."

"Nature's craftsmen, I suppose you mean," Auntie returned smilingly. "There *are* a host of ingenious workmen, manufacturers and tradesmen among them, to be sure, but haven't you rather overstepped your statement?"

"Not at all. The instinctive powers of Nature's craftsmen are all God-given; they are His own living object lessons, sent to point the way to

man. Take the hornets and wasps, for instance, they were making paper ages and ages before man attempted it; indeed it is a well-known fact that man got his first ideas of the paper-making art from these industrious little citizens, who have been living in paper houses and rearing their young in paper cradles since the beginning of Time. The beavers built the first dams, the ants and moles the first tunnels, and the mussels and nautilus constructed house-boats long before man ever even dreamed of such a thing. Then, there are the spiders—a natural born race of telegraphers; besides, long before the invention of balloons and aeroplanes, spiders had solved the problem of aerial navigation. Instances are on record of spiders being met by ships at sea hundreds of miles from land."

"Do tell!" ejaculated Max, using Grandmother's favorite expression in his astonishment. "How ever do they manage it?"

"Easily enough, it seems," smiled Uncle John, "though the spiders' methods of sailing through the air are widely different from man's." He drew the small lad down on the bench beside him, and kept an arm around his shoulders as he went on to explain: "Usually it is the young spiders that are the aeronauts. Young folks are always the most venturesome, you know. I've watched a band of spiders take to the air many a time.

They climb to the top of some object—a fence post, a weed stalk, the end of a twig, or perhaps just a hummock of earth. From this vantage point they spin out a thread, which the wind bears gently away. If it is contemplating a voyage of any extent, the spider attaches a small flaky mass, a product of its own manufacture, to the thread to increase the force of the air current upon it. On goes the spinning until the friction of the air upon the silken thread is strong enough to buoy up the spider, when it lets go with its feet, and is borne away by the wind. A novel balloonist enough, don't you think?"

"Yes, indeed," cried Tommy excitedly, having abandoned an interesting book to join the group. "I've seen 'em flying along, too, but I didn't think much about it—didn't know it was a spider ballooning, I mean. I thought it was just a spider's web torn away by the wind."

"That's the trouble with most of us, my boy," said Uncle John, soberly. "We take too many miracles just for granted. And we make miracles and direful portents of simple matters that are very easily explained. For example, a few mornings ago I chanced to be passing Deacon Trueblood's; Miss Margaret hailed me in considerable excitement, wanting me to come and see the silken sheet which the fairies had spread over the newly plowed ground where she was

going to set her rose garden. She did not know whether it was an omen of good or evil, and I was most happy to reassure her. Plainly enough a gay company of young aeronauts had assembled for an air-meet. But when they had spread their silken sailing ropes, preparatory to taking flight, the wind had been too strong for them. Try as they might they could not get the ropes to 'carry'; the wind merely blew the threads provokingly from one furrow hummock to another. Being a persistent set, as all the spider clan are, they must have spent hours in the attempt: the little plot was quite covered with the sadly strewn and tangled gossamer threads."

"We often see spider webs sparkling all over the lawn in the early morning dew," said Mabel. "Are these the threads of balloonists?"

"Not at all, my dear," Uncle John returned quickly. "They are exactly what you termed them—spider webs. They are woven in a methodically exact pattern, all as near alike as two peas, and they are, in truth, the snares which the grass spiders have spread to catch their prey. Nor are they an over-night growth. No telling how many weeks they may have been spread right there. Unless it is disturbed, a spider occupies the same web all the season, building over and repairing it when needs must. The dew simply shows up the webs to us. If you are interested

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SPIDER'S WEB

enough to investigate, you will find the little householder patiently waiting beneath its sheet for the dew to dry so that it may open up shop, or perchance it may be a nocturnal spider—a large portion of the race are. In that case, it will either be drowsing or meditating in its telegraph booth, a little tubular retreat near at hand, which has an open back door, so that it may escape on the instant, if necessary. A small awning stretches above the sheet. This is for the purpose of entangling the unwary insect in its flight. Should some poor little blunderer brush into these deftly strung threads and drop onto the sheet below, the spider is on hand instantly. For no matter how deep its slumbers or how absorbing its meditations, it listens with its hind leg! Its toe serves as the receiving instrument of its telegraph outfit, and it is quick to catch the slightest message from its ingenious sounding board."

"Oh, Uncle John!" expostulated Tommy, his tone proclaiming plainly that he considered this the baldest "tara-diddle."

"Fact, lad," Uncle John assured him evenly. "You can test its truth by looking carefully behind the web of any spider with a daytime hiding place. You will note at once a thread leading out and away from the center of the web where the spokes meet. This is the drag-line or tele-

graph wire. It also serves the spider as a foot-bridge. Follow its length closely. This is usually not over twenty-two inches, though the Angular spider, a tree species, is said to have a drag-line often eight or nine feet long. At the end of the line is the spider's retreat: in some instances a burrow in the earth, in others a leaf rolled into a little tubular shelter, in others a tent made by joining a few leaves together with bits of silk—all depending on the size and kind of the spider.

"In each instance, the spider is safely hidden, all but its hind leg; this you will find stretched out with the toe firmly grasping the line. Upon the foot of the spider is a wonderful comb-like structure which may aid it in getting messages. Go back and drop some bait into the center of the web and see what happens. Instantly the net is set vibrating, and the spider shoots down the drag-line almost instantaneously. It ——"

"Wait a minute," demanded Tommy, his interest making him both brusque and unceremonious. "How does the spider know what jarred the web? The wind must often shake it. Doesn't the spider come down then?"

"It does not," averred Uncle John stoutly. "This has been proven over and over. The spider knows the difference in the vibration made by the struggle of a prisoner and that of a mere shaking caused by the wind. It remains abso-

lutely indifferent to any but the proper summons, and then, in most instances, it rushes up at a great rate, quickly spins out a winding-sheet or shroud and binds the hapless victim securely, when it may be eaten at the victor's leisure. It is said that spiders of the larger and more intelligent species usually go over their nets once a day, and cut the ropes entangling any 'meat' that may not be strictly fresh, letting it fall to the ground. The web is then repaired and everything made ready for future business.

"Most spiders live in deadly fear of the mud-dauber (wasp). He is the little spiderling's nursery bugaboo. I read an amusing instance the other day. It seems that a certain student of the spiders' habits determined to play a trick on an orange garden spider that he had on his visiting list. Dropping around to the lady's headquarters, he quietly deposited a live wasp in her great snare.—Don't ask me how he caught the vindictive creature: I don't know!—Instantly Madame Miranda—the family name of this species—came hurrying at the summons, but ere she was quite upon her prisoner she saw his character. No doubt she was quite thunderstruck! For she stepped back and eyed her enemy warily; then, evidently reassured by her natural confidence in the strength of the entangling meshes, she moved forward cautiously, and without making any ef-

fort to kill her prey, as is usually done the first thing, she stood well away and began to spin a strong shroud, and shortly had the struggling wasp bound securely in it. Would she keep him that way and feast upon the live insect? The gentleman watched eagerly. Eating her enemy was, however, evidently the last thing in Madame Miranda's thoughts. Possibly she considered him too vile for consumption! Or mayhap she thought merely devouring him not sweet enough revenge! At any rate, she proceeded deliberately to cut the meshes which held the mummy-case, and let Mr. Wasp fall to the ground, there to lie and starve slowly to death in his unique silken casket."

"Hi!" exulted Max, pointing his chubby finger delightedly, "there's one of those balloonist fellows now! See! Yonder by the garage, swinging along on a rope of silk."

It was Sunday afternoon. The family were gathered on the west porch, a cool, leafy retreat opening from the dining-room, and they one and all leaned eagerly forward to see the aerial adventurer.

"He must be a beginner," ventured Mabel. "At any rate, he believes in playing safe! See, he has anchored himself carefully to the garage wall!"

"Good!" commended Uncle John, his very

tone giving Miss Mabel a nice little congratulatory pat. "I was wondering if any of you were going to notice that! Yonder swinging acrobat is no balloonist; it belongs to the tribe of jumping spiders, and it is one of the keenest little hunters imaginable. It swung out there on its drag-line to catch some insect winging by, and you may be very sure it was successful, too. These little fellows are quicker than scat! They never build a web, but lurk along in the shadow on the sides of buildings, trees, posts, and the like, and spring out upon any passing game which excites their fancy. They move sideways or backwards just as easily as forwards, and they can jump a considerable distance, as you have just seen.

"There are several thousand species of jumping spiders, and all of them are worth knowing. Many are bright colored, some glowing in rainbow hues, and nearly all have a thick coloring of hair or scales. Unlike most of the spider clan, the males are as large as the females. They do not dress in as gay colors, however, but they make up for this by wearing odd bunches and patches of hair on their legs. They are inordinately proud of their unique ornament, and make it a feature of their courtship. Indeed, it is said that, in some species, the little duffers dance and caper madly before the female whom they wish to attract, striking all sorts of grotesque attitudes,

even waving their legs over their heads to display their fine patches!

"They build an odd sac-like nest made up of several envelopes. Here the spiders hide during the moulting season, and here they spend the winter. Here, too, the eggs are sheltered in frail little hammocks. The young hatch early in the season, and are carefully guarded by the mother until they are ready to engage in life's business. By fall they are equal to spinning their own sac winter quarters.

"If you youngsters want a fad this summer, why not try spiders? I once heard a man say that, if spiders did not occur in our country, and we could bring in some of these wondrous little animals that spin from their bodies threads of silk of different kinds, and with these threads build homes and cradles and wonderful snares for entrapping their prey, we would all make long journeys to see them, and gladly pay the price of a heavy admission fee. Spiders' webs are to be found everywhere, and every time you discover a new pattern you may be sure of making the acquaintance of another family in the great clan. Webs are exceedingly interesting things, and you boys who have tried making snares will be surprised at their cunning. They are built in all sorts of forms, from the common irregular tangled mazes of our household spiders,

and the sheet-webs of our fields and lawns, to circles, orbs, platforms, funnels, purses, triangles, tubes, wondrous filmy domes, lamp shades, and what not.

" A common spider here in the South is known as the bowl and doily spider. This little animal —by the way, perhaps you think spiders should be called insects? If so, you are wrong. All insects have six legs; spiders have eight. Also, an insect's body is divided into three parts—head, thorax, and abdomen—while the spider's body has but two. True they look so much like insects and have so many of their ways that most people *do* call them insects. Nevertheless, they are animals. And, as I was about to state, among them are none that build a more ingenious trap than the bowl and doily spider. The central feature of the web is a well-formed finger-bowl, on the lower center of which the spider usually rests. Below her is stretched a broad sheet or ' doily,' which protects her from enemies which might attack her from below. Several inches above the bowl is a maze of entangling threads for the flying insects. The web is usually built in a low bush, sometimes on the lower branches not far from the ground. It is carefully held in place by guy ropes to surrounding twigs, and will withstand the fiercest gales."

" I'll bet I know where there's a bowl and doily

spider joint right now," exulted Tommy. "Anyhow it's a spider's nest in a bush! I pass it every evening when I go for the cows, but I've never thought of investigating it specially. How will I know the spider for sure, Uncle John?"

"It's a little brownish-yellow animal, with light colored markings. But the snare is sufficient identification; no other spider builds a web like it. Satisfy yourself that the trap is a genuine bowl and doily; then enjoy the little householder at your leisure."

"But be very careful, son," admonished mother. "Spiders bite on the least provocation, and some of them are dreadfully poisonous. Most of the large ones are, aren't they, John?"

"No, Lucy, they are not," her brother returned, positively. "Spiders are far more sinned against than sinning. It is true, of course, that spiders secrete a poison with which they kill their prey, but it does not follow that this venom would be harmful to man. Besides, spiders are timid by nature; their chief thought when cornered is escape, not fight. I have handled scores of them, and not one ever tried to bite me. Nor do I imagine one would unless it was pinched or tortured. They are not in the least vindictive like bees and wasps. In fact, it is pretty well-established now that we have only one spider in North America that is at all harmful. This is

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A MONSTER SPIDER

the Black Widow, a coal black spider, with a red spot on its abdomen. It spins an irregular web of very coarse silk, so coarse in fact that its handiwork is easily recognized at a glance. Its retreat is located under chips and stones and in holes in the ground about outbuildings. It is one that I would advise leaving strictly alone. The Indians of California, I am told, rank the Widow with the rattlesnake, and in the long ago used to make poisoned arrows by rubbing the tips with a mash made of these spiders.

"Zoölogists designate the spider as 'the class Arachnida,' getting their hint for the nomenclature from the familiar old myth which relates how Arachne, the beautiful young weaver, because of her overbearing self-confidence and boastfulness, was changed by Juno into a spider, and doomed to spin forever near the haunts of man, getting her food as best she might from the skill of her snares. Certainly many of Arachne's descendants show wondrous originality in their adaptations of the weaver's art! Not all spiders, however, in this day and age, catch their prey by means of webs. The wolf-spiders, for instance, stalk their prey and spring on it from ambush; others dig pitfalls or burrows; one species of this class has a cunning trap-door to its retreat, another builds a high turreted watch-tower. The lynx-spider comes out boldly in the open and

chases its prey headlong over the grass and the leaves of trees and shrubs, being able to jump from branch to branch with great agility. Other spiders, the commensals, live in the snares of the large web-building species and feed upon the smaller entrapped insects which the owner of the web does not care for. I will tell you about some of these interesting spider brigands some other time, or perchance you may discover them for yourselves.

"Just now I want to speak of a spider whose silk surpasses that of the silkworm. It belongs to the genus *Nephila,* and one of these days its product will come into active competition with that of the world-famous spinners. In Madagascar, where the species is common, the French have founded schools to teach the natives how to grow this spider, and to wind, spin, and weave the silk. Demonstrations of the various processes were given at the Paris Exposition, together with an exhibit of silken bed hangings woven from the remarkable material. Most astonishing of all is the method by which the silk from the *Nephila* is obtained: in the case of silkworms, you know, the silk is unwound from the silken cocoons spun by the worms as they prepare for the pupa state. The silk of the *Nephila* is pulled directly from the body of the living spider. And the method is certainly most ingenious! A little stanchion is

made to fit over the body of the spider so that it is held gently but firmly in such a manner that its legs cannot touch the thread of silk as it is spun. By lightly brushing the spinnerets a thread is started; this is grasped and pulled forward slowly and the little animal obligingly begins to spin. Silk is drawn from several spiders at the same time, and all are twisted by a mechanical twister into a single thread of the strength desired before being passed on to the reel where it is wound."

"Did you ever see the lattice spider, John?" queried Auntie. "I was reading about its odd little Oriental retreat just the other day. I've never noticed it here."

"Because you didn't look in the right place, probably," her brother returned smilingly. "I'll venture there are plenty of them right in the ivy that climbs up to encircle your windows. Just as you peer out from your retreat, so do they from behind their lattices! They are fond of an osage orange hedge, too; in fact of any dense foliage."

"Tell us about them, please," begged Tommy, "and presently I'll go and see if I can find any."

"Well," began Uncle John, in response to a nod and gesture from Auntie shouldering on him her share of the responsibility, "in the first place

the spider itself is a decidedly beautiful little creature. It ——"

"A *beautiful spider!* The idea!" said Alice laughing.

"'Handsome is as handsome does,' missy," defended Tommy, quickly. "Go on, Uncle John."

"—Has a variegated coat of white or light yellow, sometimes becomingly flecked with pink or purple," Uncle John continued quietly, finishing his sentence exactly as though he had not been interrupted, though his eyes twinkled. "It is a large spider, about one-fourth of an inch long. Its legs are yellow, shading to orange and brownish tints. It has a wide round abdomen, marked with a dark stripe or row of dark spots on each side. But it is not the spider that attracts attention so much as it is his novel quarters. His web is an oblong orb, with a meshed hub, and there is a wide *free zone,* that is a place where the meshes are lacking—a sort of open window, if you please, through which it is hoped the unwary insect will be tempted to enter. Usually there are two drag-lines leading back to the retreat. And a decidedly snug and safe little place this is! A leaf, or possibly two leaves, are drawn together to form a little tent, beneath which hangs a silken tube one inch or more in length and half as wide, woven in an ingenious lattice-work pattern which allows the spider to peer out

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SIDE VIEW OF COMMON SPIDER

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COMMON SPIDER WITH HER YOUNG

at the world about it. Smaller species of the lattice spider are often found in the foliage of trees. They are especially fond of placing their small orbs between two lobes of an oak leaf, with their tiny silken latticed tubes suspended from another part of the same leaf under a little tent formed of lobes."

"Another odd spider mentioned in the article I spoke of," said Auntie, "was the 'medicinal spider.' I suppose we have it for a neighbor, too, John? It is a stout, short-legged, oddly-marked gray spider, which lives among rocks, hollow stumps, and decaying trees. Its snare is a sheet web, with a funnel-like retreat. Time was when physicians counted on this web as a narcotic for use in time of fevers."

"There are spiders *and* spiders," resumed Uncle John. "We could write a whole book about them and still leave much unsaid. One of the first things you will observe about these little craftsmen is that spiders, like birds, are carefully clothed in protective or defensive colors. Nature has made them harmonize so well with their background, that they cannot be readily seen, either by their enemies or by their prey. A species of the crab-spider clan has this adaptive faculty worked out to a fine point. It actually changes its color to harmonize with its background! But then crab-spiders are an odd lot. You will read-

ily recognize one from its broad, stubby crab-like characteristics, and the fact that it advances sidewise with great dexterity, making much swifter speed in this hitching fashion than it can either forwards or backwards. Crab-spiders weave no snares. Some run down their prey, but most of them prefer to ambush it. Their favorite place of concealment is in the heart of a flower; hence most of them are of brilliant colors, the better to conceal their identity from the insects which come nectar hunting. The changeable fellow I mentioned, the past-master of the lot, usually parks in the white Trillium, the fleabane, and other white flowers in early spring; at this season its ground color is white. In short, it harmonizes in color and markings with its surroundings. In the fall, the colony migrates to the goldenrod, and, as has been proven time and again, in a week or ten days these white spiders turn to a yellow so nearly matching their host that it takes a sharp eye to detect the motionless spider against the goldenrod.

"Interesting as are the various spiders and their webs, a spider's nursery surpasses all. Moreover, each species constructs its egg-sacs, as the nurseries are termed, according to a definite pattern; so that it is even easier to name the nurseries than it is to name the spiders themselves. The simplest kind of an egg-sac is

merely a mesh of threads, which holds the eggs together but does not conceal them; the cave spiders build such nurseries, so do the shamrock spiders—both interesting species, by the way. Next to these come the fluffy masses of silk which effectually hide the eggs but follow no particular form; this is the design preferred by our common house spiders. Then follows a wide range of clever silk-fashioned shapes, most of which are further safeguarded by an opaque covering, or by the addition of layers of foreign substance. The egg-sac of Madame Miranda, the orange garden spider, you remember, is enclosed in a brown pear-shaped sac. On being opened, a second covering of thick flossy silk is exposed, and this in turn yields up a dainty silken cup filled with eggs. A cousin of Madame Miranda's, the banded garden spider, builds a cup-shaped nursery, with a flat top. A commensal spider commonly found in the webs of the garden spider clan puts her eggs in a dainty Grecian vase and suspends it from the web by a thin rope of silk. The grass-spider covers its egg-sacs with bits of bark and moss; another spider decorates its sac with tufts of different colored silk; and yet another with strong mason instincts plasters its silken nursery all over with mud and tucks it under a chip or stone, making it fast to its moorings with a strong thread. A certain California

spider follows the thatch idea: she fashions a series of little egg-filled discs and laps them one upon another, binding them fast with silken cords. When a string is completed, the ingenious little mother spins a silken tube down along its length for her own occupancy, and covers the whole with a tent of leaves. Another tube-loving spider, which is usually found in grass marshes and among cat-tail flags, builds a long three-sided nursery by folding over a broad blade of grass or flag, and lining it with a tubular case, which serves not only as a container for her egg-sac but as her own coffin.

"Most of the spiders I have spoken of die shortly after their egg cases are completed, and a perfectly dreadful time the little spiderlings have eating one another, until spring comes and the few robust fellows that are left break through the old storm-tattered case. Probably in a well-filled sac of eggs, not more than ten or a dozen spiderlings ever manage to get out into the big, wide world! Other spider mothers, however, live to guard their homes and to rear up the little spiderlings in the way they should go. Some of these little mothers are so devoted they never leave their egg-sacs out of sight an instant. Indeed, the majority of them will not budge an inch without packing the egg case along,—a real burden this often is, too. The first day off that I

have we will go prospecting for some of these interesting individuals. I want you to know them at first hand.

"As the spider clans are entirely meat eaters, they serve among Nature's most faithful allies in keeping in check the harmful insect hordes. Like a cat, they have nine lives, and it takes a good deal to put them out of business! They can stand any amount of fasting and privation. Indeed, there is an instance recorded of a female spider having lived for eighteen months in a tightly corked vial! If the spider loses a leg or an arm, it promptly produces a bud on the scar left by the wound, and grows a new appendage that is capable of doing every bit as good service as the part lost!"

TINY BUILDERS OF A GREAT NATION

"AUNTIE! Uncle John! *Everybody!*" Tommy called excitedly. "Do come here a moment. Here's the funniest sight you ever saw in all your life!"

And it undoubtedly *was*. A measuring-worm had set out to find the length of one of the long cement flower-box ledges in the sun parlor. His clumsy efforts had attracted a bevy of young merrymakers, some half dozen or more small red ants, and these boisterous fellows were hilariously "making the arch" every time the awkward worm lifted its body. How they crowded one another, scampering helter-skelter through to the other side, and then waiting their chance to dash back again! One just knew they were fairly breathless with laughter as they waited! And, too, it was plain that they were passing remarks over the inchworm's painstaking, laborious efforts to be altogether exact.

The Daytons watched delightedly, until the inchworm had satisfied itself as to how much longer than its body the ledge was, and had gone to conduct measurements elsewhere, and the ants

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NEST OF THE MOUND BUILDING ANT

had each taken their separate ways, no doubt all the more ready to work after their brief play.

"Well," observed Mabel, then, with an odd little murmur of satisfaction, "who says that ants don't know that 'All work and no play makes Jack a dull boy'? It's a wonder you didn't frighten them though, Tommy; they must have heard you clear down to Blake's."

"Stuff!" scoffed Tommy. "Ants are deaf as posts, at least to the kind of sounds we hear. Though I read the other day that they *do* have an organ of hearing, and that scientists think they make sounds which are inaudible to us, but which serve to carry on a language between them. Edison is quoted as saying that some day the radio amplifier will be developed until we shall be able to hear ants talk, *if* they do talk."

"We can be very sure of that," Uncle John confirmed, seating himself so evidently prepared to go deeper into the subject, that Auntie and the children—all the members of the family at home at the time—grouped themselves restfully, eager to listen. "Ants could scarcely carry on their extensive community organizations without some means of understanding one another. For all are tiny builders of Liliputian kingdoms, you know. No doubt you boys know this moment where there is a thriving city of black ants, and another of big red citizens, not to mention various colonies

of little red fellows such as those which hurried away just now. Perchance, too, you may know a great brotherhood of brown ants ——"

"To be sure," interjected Tommy, "there's a new colony being established down by the wood lot; they are building roads 'n' everything!"

"Then you know something about ant industry," smiled Uncle John. "Red, black, or brown each one is a towering monument of perseverance. And they work together each for all without the slightest hint of confusion. Just as we do in our home life, each has its own special work to do, and there is no place for the slacker. The useless old males are promptly killed off and trundled to the rubbish heap."

"I wonder, Uncle John, did you know there were brick-makers among them?" queried Tommy, breathlessly. "I couldn't hardly believe my eyes when I saw them at it yesterday. But, sure as anything, a band of laborers came scrambling up on a little mound of clay that had been heaped outside their city—clay that I'm pretty sure must have come from the storm cellar Mr. Blake has been digging. There's none like it on our farm. I was sitting close by, and as I had been there quiet for a long time, most likely they thought I was a scarecrow or something of the sort. Anyway they never paid any attention to me, and I wish you could have seen their brick-

machines get into operation! Each little workman simply took up a bit of the moist clay and moulded it into a sticky little ball or 'pellet' by chewing it. As fast as each brick was finished, the workman set it on end to dry in the sun. Being so tiny the bricks seemed to harden in no time, and a small army of workmen were soon busy carrying them to their ant-hill. But what I couldn't make out was, what use the little creatures had for the bricks?"

"They are used for the walls and partitions and even the roof of their underground apartments," returned Uncle John. "You know the real home of the ants is not in the hill itself, but in little tunnels and chambers beneath it. The entrance is a curious tunnel shaped like a funnel. We will go out there after a while and pry into matters with the glass. If the work has not progressed too far, I am sure we shall be able to see the little fellows laboring with the utmost care and precision to shape things just right. Damp clay, mixed with saliva, furnishes the mortar, and this is brought up by the most punctual of hod carriers. Instead of the trowel and mortar board which human bricklayers use, the little ant workman has its strong jaws, its arms or feelers, and its legs. But these 'tools' are quite equal to the task, and the bricklayers follow fast on the heels of the excavators.

"By the way, I suppose you have all seen the little trench diggers at work? No? Then you must watch out for this interesting sight: each one scoops the earth on its back and head, and then, with a quick movement, sends it flying out over the edge. Here it is heaped and rounded by other workers, and thus the hill itself grows apace.

"It takes a special class of workers to lay the bricks in the arched ceilings of the underground apartments, and only the very best bricklayers are entrusted with the job. Here, too, a special plaster must be used. It is made from spiders' webs and wood dust, carefully mixed with saliva. The combination forms an exceptionally gummy mass, absolutely water-proof. But think how prosaic must be the job of this painstaking bricklaying in comparison to the adventures which are the part of the little ants who go scouting for the spiders' webs that are used. What strategy they needs must use to steal their supply of webbing without themselves being caught in the clever traps which the webs form! Again, think of the duels these scouts must often wage with foragers of another clan, who seek to capture what they need rather than to go searching for it!"

"Now I wonder," Alice exclaimed, "is *that* what it was all about! Last evening, when I was picking raspberries for tea, a party of big black

ants came hurrying down between two spinach rows. Just as they got opposite my bush, they were set upon by a group of red ants of about the same size. They had it hot and heavy for a few minutes. Shortly it seemed that the robber horde was being worsted, and a half dozen or more of the blacks hurried away, leaving their comrades to finish the fight; then, what do you think, the reds rallied and killed the few blacks that were left and carried them away."

"Such doings are an everyday occurrence in the ant world," Uncle John assured. "Plainly the first party was a band of heavily laden scouts; they no doubt carried webs or clay or perchance food of some kind. And they seized the first opportunity to get away safe with their plunder. To the ants nothing matters but the common cause. Individual life is not worth a copper! Indeed, if a hunting party comes upon one of their number hard beset, they make haste always to seize the bone of contention and make off with it, but they evince no concern whatever over the fate of their comrade. Like the frontier woman who stood watching her husband wrestling with a bear, they don't care a cent which whips! It is the bit of food or material needed by the common brotherhood that counts.

"Ants are vicious fighters; neither party ever cries for quarter, and the duel is usually to the

death of the weaker, unless Chance sends a comrade to snatch and make away with the cause of the trouble. Frequently this ends matters, for the ants' concern is not really for themselves, you know, but for the cause they serve. Ants from the same colony never quarrel. Two scouts on meeting always cross antennæ, the object being, of course, to establish their identity, which scientists claim is accomplished by smell. If of the same clan, each goes her way after the brief inquiry; if not, there is quite likely to be a serious scrap, that is, if either one bears a bit of provender. Not infrequently two whole colonies engage in battle, and the victors force their opponents to be their slaves henceforth."

"Ants and bees are cousins, aren't they," queried Mabel, "and have much the same family life?"

"Yes. But there is this difference: Ants marry for life, and after the marriage flight is taken the royal pair tear off their wings. They will never leave their home again alive. The workers, of course, are wingless. And, in addition to the workers, the ant colonies are supplied with a band of soldiers. These fellows may be distinguished by their larger size, and by their great head and powerful jaws. They are usually to be found on guard about their city, and nearly always a certain number accompany the large

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A MONUMENT TO THE INDUSTRY OF THE ANT

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THE CARPENTER ANT

carrying parties. But never do they stoop to carry a load, or even so much as lend a hand in an emergency. However, if an enemy of any kind appears, they at once show their worth, and, too, when there is game that is hard to kill, they seem to take special pleasure in dispatching it. Some colonies have two sizes of workers, one large and the other small, and each does the tasks best assorted to their stature. The wonderful thing about the whole matter is that the queen mother either has the power to lay at will the various kinds of eggs to produce the different creatures in her kingdom; or else, if the eggs are all alike, the nurses have wisdom enough to care for and feed the progeny in such a way as to produce the different kinds—workers, soldiers, and once a year a family of princes and princesses. Some scientists claim it is one way and some another; but the truth is, the problem must probably remain one of Nature's secrets.

" Ants follow the pursuits of man very closely. Nearly all the trades and occupations and not a few of the professions are represented in their kingdoms. Ants are especially capable farmers. A kind of seed called ant rice is their crop. It is grown in a field ten or twelve feet square, which is marked out around the nest. Some say that the little farmers do not know enough to sow the seed. They merely stake out their farms where

there is an abundance of this crop growing. But, however it be, they promptly cut out all grass and weeds, and their field is kept so carefully cultivated that many a farmer of our race might well get some valuable pointers from these little ant agriculturists. When harvest time arrives, the little creatures go about the job most sensibly. The ant never stores away an unsound seed. Each one is carefully weighed and considered and only those which pass their rigid tests are carried to the granaries underground. If their own fields do not fill the bins to bursting, the ants go out into the highways and byways to garner grain, gathering the seeds of various grasses, and alas! some of the grain from the fields of man's sowing.

" Some people claim that the agricultural ants also dry and store up meat for winter use, but this has not been altogether proven. Sir John Lubbock found that in one large colony more than 100,000 caterpillars and small insects were brought in during a single day. Surely this number was far beyond the amount needed for immediate consumption! What more probable than that these thrifty little creatures had in mind the winter's needs? King Solomon evidently thought so; remember his admonishment, ' Go to the ant, thou sluggard, consider her ways, and be wise,' which having ' no guide, overseer, or ruler, provideth her meat in the summer, and gathereth

her food in the harvest.' Surely we can believe almost anything of a little creature that is wise enough to store grain in the ground so that it neither rots nor germinates!

" Almost as clever as the agriculturist ants are the little gardeners which grow mushrooms. These enterprising little people are the parasol ants of tropical countries. To be sure, the mushrooms which they grow are not the kind preferred by man. They are a sort of spongy mold growth, *ant mushrooms,* if you please, and the little creatures are so fond of them that they will sacrifice their lives to protect their mushroom beds, which are made in numerous little tunnel-connected underground chambers, about the size of a man's head. The fertilizer for these beds is composed of leaves specially treated, and it is from their manner of carrying parasol-style the bits of leaves which they cut from the trees that the little creatures get their name of parasol ant. But alas! often in their zeal to stock their beds these ants quite strip a tree; so that their presence in a neighborhood is a menace.

" Among the parasol ants, as in all colonies of the insect world, there is a careful division of labor. The ants which do the carrying do not make the beds. This work is in charge of experts. First the bits of leaves go to the leaf-cutters who cut them into tiny fragments. A

second band gives each piece a thorough washing and cleansing, by carefully licking it all over on both sides. Then the pellet-makers tackle the job, and the fragments are chewed and rolled into small balls, after which they are carried to the gardens by another force and pressed carefully into the surface of the mushroom beds. If it is a new bed, no doubt mushroom spawn is then scattered; in the case of rebuilding old beds, enough spores probably remain to start the new growth. In either case, it is only a few days until the little leaf pellets are covered with a fine growth of white fungus threads, which flourish freely so long as the mass beneath remains light and spongy. When a mushroom bed becomes too exhausted to furnish further food for the ant hosts, the little creatures turn their cattle in to clean up the rubbish. These cattle are a special kind of beetle, which the ants lick carefully, getting something akin to milk which the beetles secrete.

"All ant colonies keep cows. But it is the aphis, or plant louse, that is considered the true milch cow of these intelligent little people. It gives a sort of honey-dew which is much relished by the ants, and the little creatures have proven themselves very shrewd dairymaids. They not only raise and care for their cows, often carrying them bodily from one pasture to another, but they drive away their natural enemies and pro-

tect them in every way possible. More than this, each race of ants seems to prefer a certain breed of cows. The big black ants, for instance, have green cows which they pasture on the leaves of the red maple or the box-elder. The small black ants of the cornfields keep a grayish-white cow, which feeds on the corn rootlets, so voraciously sometimes as to do great damage to the fields. The big red ants herd their bluish-gray cows around the roots of the apple tree. The brown ants keep their cows on the tall grass which is always to be found growing near their cities. Not only do the ants seem to know just what food each breed of cattle requires, but some folks think that each ant has its own *private cow!* Always, wherever the cows are kept, herders are stationed to guard them, and not only do they drive away any prowling creatures, but often they build cowsheds of earth over the drove for their further protection.

"The yellow meadow ants seems to run genuine dairy farms. It is said that they often have four or five different breeds of aphids under their protection. In winter, their cattle are carefully transferred to underground stables. More than this, these skillful little people painstakingly gather up all the aphid eggs they can find in the fall, and treasure them carefully in a nursery built for this purpose. The eggs are turned and

tended each day, until they hatch in early spring time, when the 'calves' are brought up and turned out to pasture on the particular foliage which each species requires."

"I was reading something about that very point just the other day," Auntie observed. "It seems that a noted scientist had tried in vain to rear a drove of aphids from some odd black eggs he had discovered. He succeeded in hatching the young all right, but they would eat nothing he brought them, and finally starved to death. So, having the good fortune to come upon some more of the eggs later in the season, he wisely carried them down to the yellow meadow ants. These little people apparently accepted the offering in great glee, and lost no time carrying the eggs below. Days and months passed, and then came the time for the annual spring pasturing of the young aphids. The scientist watched carefully, but he saw no young calves resembling the ones he had lost, and finally he concluded the ants had been as unsuccessful as he. He was on his way back to his laboratory, trying to forget his disappointment, when he stumbled upon an ant cowshed strongly built and double guarded. Evidently here was a special prize herd. On examination, what should he find but the very calves he had longed for, feeding contentedly upon the foliage of a daisy plant and apparently thriving

heartily. The good man was amazed; for never before had he seen the ants using this plant as a feeding ground. It was proof positive that the little dairy farmers certainly knew their business!"

"We might talk all day about ants," said Uncle John, "and then not finish the subject. But there is one thing more that must be added: do you know that many ants keep pets? Tiny house 'dogs' and 'cats,' mostly of the beetle clan, which frolic and gambol about their owner in the most playful manner imaginary? Odd, isn't it!"

SOME CLEVER WEAVERS

"TALKING about Nature's craftsmen," observed Mabel, tossing aside her big sun hat and joining the porch group sociably with her embroidery in hand, "I have just been watching Madam Baltimore Oriole at work upon her swinging cradle. You know Tommy located the nest yesterday in the big elm by the garden gate. And surely nowhere is there a more clever artisan, not even excepting Arachne's most talented descendants! Who would ever dream that a little bird could make such a home with her bill—slender and needle-like though it is? Why, there isn't a man or a woman in the whole country who could do such a thing with only one tool! The nest is going to be a veritable triumph of weaver's art. It looks like a miniature nose-bag such as teamsters use for their horses. It is made of plant fiber and carefully lined with down and wool. I saw her bringing wool from the pasture."

"Where was Peter?" interjected Max. "Wasn't he helping?"

"Not unless we give him credit for supplying

inspiration," laughed Mabel. "Indeed, his gay, high-whistled notes fairly bubbled over one another all the time, but to me it sounded suspiciously like he was trilling a rollicking, self-congratulatory sort of chant: 'Let the women do the work! Let the women do the work!' His wife didn't seem to mind, though. I rather fancy she was so interested in her intricate pattern that she never even heard him! Round and round she went, painstakingly weaving in material to make her clever little cradle warm and strong, all the time clinging to the nest with her feet, and working from below, poking the thread up and pulling it down through the width of two or three rounds in order to make it solid. Grasses, strings and horsehair seemed to be what she was using for the outside, all woven and blended together in the most wonderful fashion. You would never think a little bird could do such nice work! I don't know when I have been so interested. Just imagine being a baby oriole and swinging high up in the elm tree, in that odd hanging pocket, to the tune of the old Wind's low-murmured 'Rock-a-bye, baby, in the tree top!'"

"*Peter! Peter! Clara Peter!*" The reply, or the interruption, however one chose to take it, was the Baltimore oriole's own contribution. He had settled all unnoted in the tip-top of a lilac bush close by, and his words gained immediate

attention. For those on the porch turned to him gladly, and a general smile went round when Max translated the high-whistled notes which followed as, "Little boy, you better look out! Little boy, you better look out!"

And then the lad shook a chubby fist at the bird: "Don't you go mistaking me for a cradle snatcher, Mr. Peter," he admonished laughingly. "You are a sorry husband, sporting about here and there, and leaving all the home building to your gentle little olive-clad mate. You'd best sing out your name a little louder. Mrs. Clara Peter will think you are gone for good, and take that dashing cavalier that was whistling around here yesterday."

Mayhap the well-groomed black-and-orange clad fellow held that "A hint to the wise is sufficient"; at any rate, he was away instantly—a flash of fire through the air, while in the wake of the "feathered meteor" floated a volley of gay, high-whistled notes.

"The darling!" murmured Auntie, appreciatively. "I'm sure I love the Baltimore oriole more than any of our bird friends. He is so *human.* One can get almost anything out of his notes—sympathy, humor, admonition. Hand me that book, Alice, please. There are some lines on the oriole that I am sure you will all appreciate:

"'How falls it, oriole, thou hast come to fly
In tropic splendor through our Northern sky?
At some glad moment was it Nature's choice
To dower a scrap of sunset with a voice?
Or did some orange tulip, flaked with black,
In some forgotten garden, ages back,
Yearning toward Heaven until its wish was heard,
Desire unspeakably to be a bird?'"

—Edgar Fawcett.

"The orchard oriole is another clever little weaver," Uncle John informed. "She cannot equal her cousin Baltimore in craftsmanship, but yet she does very neat work. Her nest is never a swinging cradle; just a plain cup-like nest, of modest basket-work, placed securely in the fork of an apple tree. But the dried grasses are chosen with great care, and the strands, when unraveled and measured, have been found to be of almost equal length. So you see this little weaver is very skilful, and knows just the care and precision necessary to get the best results. You would enjoy watching her at work. But you will have to look sharp to catch her at it. She is even more demurely dressed than Mrs. Baltimore and shy to a degree that almost borders on the recluse. Her husband, too, is more apt to be heard than seen. His voice is high and rich and full of a joyful brilliance that Burroughs says is like scarlet. He is clothed in rich velvety wine-red, where the Baltimore wears or-

ange. There are not many pairs of these industrious orchard friends in these parts, worse luck, for man has no better friends.

" The past-masters of the weaver's art in Birddom, however, are not the orioles, incomparable as their work may seem. The palm goes to a species found in the tropical country called the weaver birds, and there are some three hundred or more members of the clan. Naturally among such a large host we must expect to find a wide variety of nests, varying in shape according to the birds' individual tastes, and woven of fine branches, roots, or grasses in accommodation to circumstance. The most common form is that of the pouch cradle, similar to our Mrs. Clara Peter's. One species builds a kidney-shaped bag, with the entrance at the side; others prolong their pouches into tubes and enter from below. The yellow Baya weaver fashions a curious stocking-like nest, with the cradle or nest proper in the heel, and the entrance through the leg. Her cousin, the Mahali, constructs a bottle-shaped affair of reeds, that gives to her the common name of bottle bird. But the most wonderful nest of all is that fashioned by the various tribes of sociable weaver birds, who congregate in large numbers, often building as many as three hundred nests under one general roof.

" These sociable weaver birds are very remark-

able workmen, and go about their labor with the utmost intelligence and skill. After selecting a lofty tree, with good screening foliage, in some retired and sheltered place, all hands get up the materials for nest building. Dry grasses, bits of twig, root fiber, and plant down are brought in and piled about on the ground in neat orderly piles, just as we would place our lumber, cement, and sand, if we were going to build a house. Moreover, like the true architects that they are, these little weavers first put up their framework and shingle their roof, so to speak. The toughest and longest of their root fibers are selected and draped over the branches and made fast. These are the rafters, and when all are in place they are ingeniously woven and interwoven with fine grasses until a splendid, water-proof, umbrella-shaped roof is secured. Only the females work when it comes to the weaving; the men are too awkward and clumsy, I suspect, to be trusted with the delicate threads. They would be most certain to catch a toe-nail carelessly somewhere and undo the work of hours, perhaps past repair. It is safer not to have them on the scene.

"Once the roof is done, each little housewife fashions her own special nest pouch. These are made of much the same materials as were used in the roof construction, and are carefully woven fast to it, and lined with the softest plant down

and fine grasses. So close are the nests hung under the roof that they are only separated from one another by their walls, and notwithstanding that to all appearance they are as near alike as peas in a pod, no little social weaver madam ever makes the mistake of entering her neighbor's nest. Straight and true she flies to her own door on the brief occasions when she must be absent after the brooding begins.

"Weaver birds have a variety of colors: some of them are green; others are brown or gray, variously marked with white or yellow; still others are more gayly clad in crimson or in golden yellow. No species is larger than our canaries, and all are cheery and good-humored, keeping up the liveliest kind of 'conversation,' even when the wearying business of brooding is in hand. If you ever have the opportunity of visiting a large museum, you must be sure to ask to see the nests of the weaver birds. No nest is ever used but one season, and it is a common practice to suspend the new nest from the old one. A certain Madagascar species, it is said, often makes as many as five nests in succession, one hanging to another. Not infrequently, so great is the weight attached as the years go on, that the roof gives way, and then, and usually not until then, do the little happy-go-luckies build a new umbrella. The thorny acacia is one of the favorite homes of

these little people, and if the branch hangs out over the water so much the better, as they are thus more secure from predatory animals.

"The cheery little weavers are favorite cage birds in their locality, though it is their plumage and happy dispositions which commend them, as the majority have no wealth of song. Of these the wax-bills, with their coral-red, waxy beaks, and the Java sparrows or 'paddy' birds, in their pleasing coats of pure white, or of purple-slate and black, are the most common. Another extremely curious little weaver is known as the widow or 'widdah' bird. Although it is no larger than a canary, it has a wonderful draped tail almost a foot long. Originally the name 'widdah bird' was applied to a Portuguese species, which was garbed almost entirely in black, the long draping suggesting a widow's weeds. Tropical species of the male 'widdahs' are often gayly decked out in colors rivaling the most gorgeous parrots, while their gift of song further makes them much prized as cage birds.

"You will find a plate of Pensile Nests of Birds in the encyclopedia. First of all is the odd little pocket of the Australian flowerpecker, a little bird that is a near kin to our black and white creepers. Its cradle does not differ greatly from that of the Baltimore oriole's, save that it is closed at the top and the entrance is made through a lit-

tle window in the side. Below this is a row of queer, gourd-shaped nests belonging to the crested caciques, some social South American cousins of the orioles. These clever weavers fashion their nests of grass and thin bark, often prolonging the gourd handle fully a yard in length, the better to protect the birdlings from monkeys and serpents.

"Another interesting example is the nest of a European titmouse. It is woven in an odd sac-like shape, with a short tube for an entrance hall. Another pensile nest, which while not built by a weaver is of such ingenious craftsmanship as to command immediate attention, is the nest of the tailor bird, a little friend in feathers that is a familiar visitor about the lawns and gardens in India. The nest is a skilfully fashioned cup, which is held in place by neatly stitching two leaves together, usually with strands of thread.

"Then there is a beautifully-woven cup-like structure of bark and plant fiber fashioned by the red-eyed vireo or 'preacher bird' as we commonly call it. You have seen a specimen of this nest at first hand. Remember the one I sent to the college museum last fall? It was all decorated with wool, spider webs, and twine, and flaunted a gay ribbon banner, mute evidences of Madam Red-Eye's artistic temperament. I've a general idea of where a vireo domicile is being es-

tablished right now, and I am purposely leaving out all manner of things for its embellishment, but I've not much hopes of actually seeing the nest until the screening leaves have blown away at the call of Jack Frost. The site is in the very tip-top of one of the maples on the lawn, and Sir Red-Eye's voice every time I approach gives me most plainly to understand that a close acquaintance is highly undesirable."

A FAMILY OF ROPE DANCERS

"I saw a funny thing as I was coming from school this evening," Tommy volunteered, as the family sat on the porch in the gloaming. "Farmer Blake's lambs were having the time of their lives playing 'Follow My Leader'! *He* was the cutest little black-faced woolly specimen I've seen in many a day, and a race he led them for sure! Twice around the big rock, then up its sloping side, a jump off, and around again and again, and every little caper and antic he cut, so did all the others. It was too funny! I laughed till my sides fairly ached. Isn't it queer anyway how sheep will always follow the first, wheresoever it goes?"

"It certainly is," Auntie agreed heartily. "But they have been at it since the beginning of time. You know the old tale of Farmer Dingdong's sheep, and how when a cruel trickster threw the old ram into the raging sea, all the others jumped in after him, one by one, and were drowned before a hand could be turned to prevent the foolish sacrifice."

There was a chuckle from Uncle John, as he

laid aside the book he could no longer see to read, and came to sit beside the boy on the steps. "I've just been reading about the 'sheep' of the insect world," he said,—"a curious band of pine caterpillars, which feed upon the true pines of the Old World. Fabre calls them a family of rope-dancers, because they walk a tight rope all their lives. Indeed, they can get about *only* on this rope, which is a sort of silken rail placed in position as the caterpillar goes. Their sheep-like propensities are shown by the fact that they always march in single file, each one touching with its head the rear of the one just in front of it, and all following the wavy turns set by their leader with scrupulous care. Pine processionaries is another name given to these orderly little rope-walkers. Would you know their life story? 'Tis more interesting than many a fairy tale.

"It begins with the eggs laid by the pine moth. These are hidden away in a curious little golden-russet muff wrapped about the base of a whorl of pine needles. At first glance this muff has a silken appearance, but closer inspection shows that it is really covered with little scales, soft as velvet to the touch, which overlap one another to make a perfectly water-proof case. Clip away the scales, and lo! there is revealed a pearly little spike for all the world like a tiny cob of pop-corn. Each pearl is an egg, and the marvel is that an

insect can execute anything so geometrically perfect and regular. What law of beauty and order impels her to this matchless workmanship?

"The eggs hatch in September, and from each little muff comes three hundred or more tiny pale yellow caterpillars, with black heads almost twice as large as their bodies. Immediately they begin to feed upon the pine needles on which their nest was placed. These gone, instinct swings them promptly into line and the little processionists follow their leader in search of fresh pasture. As he goes, this little captain whom chance has thrust to the fore dribbles a tiny white thread from his mouth, and sticks it fast. Behind him the next one dribbles his thread and so doubles the slender rail that is yet so faint no eye can trace it; a third trebles it, and so on until all in the procession have added their bit, and there stands revealed in the wake of the passing van a fine white thread, which is no more nor less than a little silken tapestried roadway which later serves as a guide rail to carry the little creatures back. For, when all have eaten their fill, they begin to think of slumber, and naturally the nest is the proper place for this business. So instinct again teaches them to fall into line; the leader after much blind reaching and hesitation feels beneath his lips the silken rail that marks the homeward path and makes haste along it, picking up silk as he goes. After

him comes the van, following his example with sheep-like accuracy, and thus presently the home site is reached, and the tapestried road is no more.

"But the sleepy caterpillars cannot settle at once to rest, for there is no shelter. The scales of the muff which covered them were scattered to the four winds in their advent. What is to be done? 'Spin a tent!' whispers instinct, and the little caterpillars obediently set their spinnerets in motion. Shortly, by their combined efforts, they have made a little ball of gauze about the size of a hazelnut. It is securely fastened to a broad leaf, and offers a blessed haven for the time being. The tired little processionaries creep into it, doubtless with thankful hearts, and proceed to sleep straight round the clock, not even deigning to open their eyes—if the tiny specks on their black sealing-wax heads *can* be called eyes—until night is come again, and their clamoring stomachs insist that food must be supplied. Then again instinct draws them up in a line outside, and the leader promptly starts on a tour of investigation, dribbling his silken rope as he goes, and carefully followed by the whole sheep-like procession of dribblers, who thus make sure a guiding line to direct their safe return from the labyrinth which their uncertain needle-pasturage forms. 'Tis a wise provision. Theseus himself would have been lost in the mazes of Crete, you

remember, but for the clue of thread with which Ariadne supplied him.

"Do the processionaries return to the feeding-grounds of the night before? Hardly, since they cannot see, and the direction of their expedition is left entirely to the fickle vagaries of the groping wriggler at the head of the file. How does he manage to find pasture at all; can it be that he smells it? Fabre proved that this is not the case. A host of hungry caterpillars from his insectary passed close beside a pine branch, after long hours of fasting, without betraying any eagerness or showing even a desire to stop. No, they recognize food only by touch. So long as their lips do not actually brush against the pasture, they will proceed on in their wavy line.

"Apropos, the old French naturalist once cut the tapestried way of a group of processionaries who had gone out to take an airing by marching round the rim of a flower-pot near their nest. And, what do you think? Cut off from their way of retreat, the stupid things fell to circumnavigating the pot, going round and round on their silken trail; not one of them, though they must have been nearly famished, ever guessing that a trick had been played, and making almost no effort to strike out in a new path. Only nine inches from home and food, there they kept up their ceaseless, nosing march, till the afternoon of

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PROCESSION OF CATERPILLARS

the *eighth* day. Then a trail laid in the disorder of an especially cold night tempted one reckless, ravenous processionary from the straight and narrow way, and ultimately he led the file down the side of the pot to home and happiness. Fabre figured that they had walked for eighty-four hours, and had covered considerably over a quarter of a mile while traveling in a circle."

"The little ninnies!" ejaculated Alice. "Do they ever lose their way entirely and come down to the ground in their search for food?"

"No. Apparently the same wise Power guides them who teaches the birds their way along the 'pathless coasts of air.' But they do come to the earth sometimes, venturing boldly abroad in the daytime. Moreover, according to Fabre, the trippers have nothing in mind but a little constitutional; albeit it is possible that they may be on a tour of inspection, looking for a suitable sand location in which to bury themselves later on for their metamorphosis."

"And what about their tent?" queried Tommy interestedly. "Of course they must soon outgrow it?"

"To be sure," returned Uncle John, promptly. "I was coming to that. After each return from the refreshment table, the processionaries work a bit on their shelter before turning in. Sometimes it is after two o'clock before their 'All's well!'

sounds and they creep to bed. Thus, the tiny tent that was the size of a hazelnut in the beginning grows in two weeks to the size of an apple. If it has been well established in a central position, the processionaries may go on enlarging it into elaborate quarters. The chances are, however, that they will pitch two or three tents before the approach of fall warns them that they must build a snug habitation for winter. This work is gone at with great ardor. A site in the very tip of the bough is selected, and here by weaving a network of silk about the leafy clump a structure is fashioned that is stout enough to defy the fiercest blasts of Boreas. When completed it is as large as a two-quart measure, and by creeping into the milk-white mattress in the center, composed of thick ropings of silk around a cluster of leaves, the little caterpillars can keep as snug as the proverbial bug in a rug.

"By this time, too, their own mother would never recognize the pine processionaries. For they have donned their winter garments—a plain little coat of whitish-yellow, with six funny little red patches on the back, surrounded with scarlet bristles. Set in the midst of each red patch are specks of gold which add not a little to their unique decorations. That the caterpillars are proud of their new wardrobe is very evident. There is a little veranda on the top of their house,

and here they may be found every pleasant day throughout the winter, lolling about and displaying themselves, steeping in the heat of the sun, and occasionally wagging their heads to show their enjoyment.

"Along in January a second change of dress is made. This is a plain utility suit, which possesses one extremely handy feature. In a row down along the back are eight little mouth-like gashes which have inside them some odd swellings so sensitive that they record the changes of heat and cold. They are, in short, living barometers. By their aid the processionaries are enabled to gauge accurately the weather, and thus do not venture forth in the teeth of piercing winds, storm and sleet, as they might otherwise do. They have been known to foretell a storm at least two days ahead. Fabre says that when his family had to go to town in winter to buy provisions, they always consulted the caterpillars, and according to what the little creatures did, they went or stayed at home.

"It is March before the processionaries leave their pine tree for their final journey abroad. They are now much faded as to coats, but their ability to follow grimly in a steady, unbroken procession still holds good, and they file away over the uneven ground. Their business is very important, and it takes no little patience on the

part of man to await the issue. For, while they are only going a short distance by our standards, to the caterpillars the way seems long and toilsome, and it is perhaps a good two hours before they bring up at a spot where the soil is powdery and dry enough to make digging easy. Every now and then the caterpillar at the head of the row pauses and digs a little. The others wait in sublime trust; whatever his judgment, they will follow him implicitly. A half dozen or more trials may be made before the leader is satisfied, and settles down to real digging. Then the line breaks into a swarming heap, and shortly the caterpillar backs are joggling in unison, as their feet and jaws make the loose soil fly. Little by little each one 'digs himself in,' and presently there is nothing to show of their presence but a little mole-like ridge rising and sinking, quivering with the haste of the eager burrowers; then all is still. The caterpillars are safe in their sand cradles, some two or three inches down, and after a short rest, will begin to wrap themselves in a cocoon.

"The latter part of July or August the pine moths come forth. They are delicate creatures with flimsy wings and great sweeping plumes: how do they ever manage to force their way out through the hard rain-washed, sun-baked soil, without utterly ruining their finery?"

"I know," cried Tommy, eagerly. "I've seen

'em—not pine moths, of course, but other kinds. They have their fine garb all swaddled around them. The wings are tight against the breast, the plumes are folded down along the sides, and the hair fleece laid flat."

"Yes," said Uncle John, "the wings of the moth are not merely soft and folded, at emergence, as is commonly supposed. They are actually undeveloped and grow in size in a very short time. I have a record of a polyphemus with wings only about one-half inch long when first observed, and each wing grew in thirty minutes to three and a half inches. You could actually see them grow. You see, the moth is just like a hard little cylinder, with a funny deep-ridged head, which she uses for a boring-tool. Not until she is free of the earth does she shake out her finery."

"I have a lot of beautiful specimens in my collection," said Tommy eagerly. "I wonder if I could get hold of a pine moth?"

"I doubt if you would prize her greatly," Uncle John returned. "She is not very gorgeous, being clad in plain gray, streaked with brown here and there. She has white under-wings, and a russet girdle covers her abdomen. The tip of her body is her only really remarkable feature. This shines like pale gold, and on examination proves to be covered with a fleece of russet-gold

scales. Touch them ever so lightly and they fly off in a shower. Moreover, now we note that these scales are exactly like those with which the little pine muffs are thatched! Like the eider duck, the pine moth tears off her fluff to make a cozy nest for her babies."

INTERESTING TUNNEL BUILDERS

"TABBY brought in the queerest little animal a while ago," observed Alice, as she came from hoeing in the rose garden, and seated herself on the steps beside Grandfather. "At first I thought it was a young rat, but it didn't have any eyes worth talking about, and its head was longer and much more pointed, besides its front claws were fitted out with little spades like the moles have. But it wasn't a mole, I'm sure of that. And it had a funny musky odor. Neither Tabby nor her kittens seemed to want to bite into it, though the kittens had a big frolic with it. I laid it up on a post intending to bring it in, but some way it disappeared."

"I think Jim Crow could tell you where it went," returned Grandfather, laughingly. "He went cawing past here a few minutes ago in great glee. Tommy thought he had caught a mouse, and set off after him. I saw the lad headed for Daddy Thornton's with Jim under his arm just as you came in the gate. You know Mr. Thornton contends that crows are the greatest villains alive, and he and Tommy have a never-ending ar-

gument about it. I suppose the boy thinks *now* he has some real proof of Jim's usefulness. Ha! Ha!"

"Poor Tommy!" said Alice, but she laughed too. "Maybe Daddy Thornton will know what the creature is," she suggested then.

"I think I can set your mind at rest on that score," Grandfather returned, removing his glasses to wipe away the mist his hearty laughter had called forth. "It was the short-tailed mole or shrew. There are some thirty-five species of shrews, I believe. Most of them grub about among the roots of herbage in the gardens, fields and woods, making runways beneath fallen leaves and hiding in old stumps and under rotting logs. They eat various insects, caterpillars, and earthworms, and are useful aids for the gardener. The long-tailed shrew mouse which lives in the marsh is the nursery bugaboo of our dainty little songsters, the marsh wrens. The mole shrew is the only one of the family that forces its way through the loose top-soil like a mole. He, too, does not hesitate to dine on birdlings. In spring, the males are particularly pugnacious, and often fight to the death. We may find the body of the vanquished one in the garden path, but we seldom stumble upon the contestants, as they are nocturnal creatures, and do not usually venture far abroad until man is safe in bed. They form the

prey of weasels, hawks, and owls; the butcher bird, too, frequently hangs up a shrew pelt; and the house cats unhesitatingly pounce upon the unwary prowlers, but they will not eat the flesh, because of the musky odor which you noted. Moles and hedgehogs are close kin of the shrews."

"A mole has begun to throw up its galleries down in the pasture," Alice informed. "Serpentine figures, Uncle John calls their elevated tunnels. He and Tommy were holding high counsel over traps last evening."

"Moles are unmitigated little nuisances," averred Grandfather, stoutly, "and yet not one of the little craftsmen you have all been interested in lately can outdo a mole in zeal; weaver, mason, carpenter, what not, he is the greatest worker of them all. And with reason: he is compelled by stern necessity. His appetite is so enormous that he is incapable of undergoing even a slight fast. He lives almost entirely upon earthworms, and it is in search of this prey that he drives his long, zigzag tunnels. The depth at which he works depends upon the season. In spring, when there is plenty of moisture in the ground, the tunnels run along close to the surface, and it is then that our ire is roused. For besides marring the velvety smoothness of our lawns, the tunnels uproot and undermine our favorite flowers and shrubs, and raise havoc gener-

ally. Later in the season, when the drouths come on, the earthworms go deeper, and so do the moles.

"The mole's ravenous appetite makes it an excessive drinker. It *must* have water. For this reason, if there is a brook or stream in the vicinity, one of his galleries runs to it. If water is not to be had in this way, the clever little chap digs his own wells, here and there at convenient intervals in his subways.

"Some people claim that moles break their furious pace with rest, turn and turn about: thus three hours' work, then three hours' rest. I do not know about this, but I do know they are always to be found hard at it about sun-up, again around eleven o'clock, about one o'clock P. M., and then in the evening about sunset. But you will need to approach with caution if you expect to catch one at work. The little creatures have no eyes worth mentioning; they have little use for sight in their darkened tunnels. But Nature has endowed them with a wonderful power of smelling and hearing. The least sound and not only do all motions cease, but the little worker, knowing perhaps how well he merits punishment, dives at once into one of his winding galleries and hurries away. It is no trick to take one, if you can steal up unawares, armed with a trowel and a hoe. Stick the trowel into the passage just be-

hind him so that he cannot retreat, and dig him out with the hoe before he has time to think! I would rather trust to this method than to all the mole traps that were ever invented.

" Moles are good swimmers, and can pass from bank to bank, or from the shore to an island with the greatest ease. Each mole has its own habitation and its own hunting-grounds, and woe to the poor blunderer that ventures to trespass in strange precincts. For the mole is as furious at fighting as he is at working, and his teeth and claws are most formidable. In places where the moles are so plentiful as to have established a mole colony, there are certain underground highways which are common to all. And one general road law is most punctiliously observed: if two moles meet, the smaller one promptly retires into a gallery and lets the august one pass. In case two strong prideful knights meet, usually neither one will give an inch, and there is a fight to the death.

" The mole's nest or home is very remarkable. The animal first throws up a mound of earth which it packs and presses firmly. Then a circular gallery is run around close to the top of the mound. Some distance below a second and larger circular gallery is run, and the two subsequently are connected by five straight passages. Next a central chamber is constructed between

the two circular galleries, with openings into all the passages. Here the mole sleeps, and from this safety chamber he can escape at a moment's warning. Food prospecting in seasons of drouth is carried on from the lower gallery, and in time passages branch and counter-branch from this in all directions. The young moles are brought forth in litters of four or five in the spring; some claim there is also a fall litter, but the point is debatable. The young are not born in the central sleeping chamber, but in a special nursery which has been carefully lined with leaves and other warm materials especially for their coming.

"Moles are wonderfully adapted to their peculiar manner of life. Witness first their soft beautiful coats of fur, which are always smooth no matter in which direction they are brushed. This is very fortunate; if the mole's fur ruffled up like some furs do, he would have all sorts of trouble in his tight-fitting passageways. Again, his spade-like paws are peculiarly fitted for shoveling dirt. Each paw is composed of five fingers, which are armed with strong, sharp claws. The paws are turned outwardly so that the mole can toss the dirt to one side with little exertion. Moreover, as the creature must spend its life digging, its strength is nearly all placed in its shoulders and paws, where it can be used to the last ounce.

"Moles vary in color. Those we are familiar with are of the peculiar grayish-brown tint, recognized everywhere as 'moleskin.' Black moles, however, are not uncommon; there is a white species, too, and the cape or golden mole is often of a decidedly orange hue. In Germany, the mole is termed the *moltwerf:* from the words *molde,* dirt, and *werfen,* to throw. It seems a happy combination, for certainly nothing can throw dirt with greater zeal than the mole, unless perchance it may be the woodchuck."

A MARVELOUS MANUFACTURER

"No doubt you folks all remember our talk about the spiders some days ago," Uncle John observed, as he rose from the table one Sunday, after lunch. "As soon as the dishes are washed, there will be an expedition down to the brook in the west marsh to pay our respects to a certain marvelous trap-maker and manufacturer that has taken up her abode there; every one who has no previous engagement is invited to attend."

There was a chorus of delighted exclamations and the dishes began to disappear kitchenward with such alacrity that in an incredibly short time Uncle John, Alice, Tommy and Max, and little Ruth were off upon the two-mile hike.

"It is the banded spider we are going to see," Uncle John informed them, as the party drew near the end of their journey. "She is one of the handsomest members of the spider clan. Her fat little body is as large as a hazelnut, and she is adorned with alternate sashes or bands of yellow, black, and silver. Even her legs carry out the band idea, with their dark brown and pale brown rings. There! What do you think of that for a

hunting weapon?" he ended triumphantly, as an abrupt turn in the path disclosed to view a large upright web, which spanned the little brooklet from bank to bank, being made strong and fast by secure moorings to the flags and rushes which overhung the stream on either side.

"My word!" ejaculated Tommy in surprise. "It might do for a tennis net in a pinch! What does the spider need of such an extensive affair?"

"I think perhaps she is ambitious and loves a fine house," Uncle John returned, "though, of course, the larger the web the more sure she is of not having to go to bed supperless. At best, you know, the creatures who are foolish enough to rush pell-mell into a web must be rather few and far between."

"Certainly she is an artisan of rare merit," said Alice admiringly. "Just see how symmetrical and well proportioned her work is! The spokes spread out from the center like an extra stout wagon wheel, and the cords or cross-bars run around in an almost perfect spiral. And look at that thick, wide ribbon running zigzag across the spokes from the center toward the lower corner! I suppose that is her trade-mark, Uncle John? No doubt those queer little marks crisscrossed in the silk spell something in spider chirography. I wish we could read them!"

"Very probably they stand for banded spider,"

laughed Uncle John. "At any rate, no other spider uses a signature just like it. Madam Miranda, the orange garden spider, runs an odd staircase a little way straight up and straight down from the center of her large upright web. That is her signature. Other orb weavers also have their special way of signing their work. I —— Wait a minute, Tommy! What is that you have?"

"A grasshopper, sir. It's all right to offer to the banded lady for refreshments, isn't it?"

"By all means. Toss it squarely into the meshes toward the top of the net, and let us see what happens."

Seated motionless in the center of the web, with her eight legs widespread to feel even the tiniest vibration of her silken lines, the keeper was calmly waiting what Fortune might send, apparently entirely oblivious of the party a little way down the path. When the big grasshopper went whizzing dizzily from Tommy's good baseball arm, and landed with a resounding kerplunk that must have jangled her telegraph wires furiously, she started up with lightning-like agility and made for the scene of action at a great rate. But, ere she had quite reached the frantic, struggling grasshopper, which seemed to know full well its peril, she paused and promptly whirled about. What was the matter? Was she afraid

to tackle the huge specimen? The children eyed her disappointedly. "Coward!" muttered Tommy, disgustedly, and was turning away. But Uncle John caught his arm. "Watch!" he whispered tensely.

And even as he spoke a curious thing happened. The spider's hind legs began to wave vigorously, and shortly they seemed enveloped in a rainbow-colored, fan-like sheet which grew apace, and was presently flung with surprising quickness and nicety over the writhing grasshopper. With a quick movement of the long whirling legs, the poor wretch was turned over and securely bound in the shimmering shroud. But not yet did the spinning operations cease; on and on went the waving legs flying their bright-hued sheet, and at the release of each armful, or rather "legful," a quick kick sent the victim turning over more firmly in its shroud. It was wonderful to watch, and the performance went on until it was quite apparent that the spider had used up all her silk.

But the grasshopper still struggled. Feebly, 'tis true; he was too tightly swaddled for any concentrated effort. The spider faced him and stood patiently. Evidently she had every confidence in her methods, and she had not long to wait. Soon all motion ceased beneath the variegated shroud. Then the little murderess ad-

vanced to put the finishing touches. Quickly she thrust her poisoned fangs in here and there, and then, after another interval, began quietly to "bleed" the corpse. This done, she was evidently quite satisfied for the moment; she would eat the meat at her leisure, and she proceeded to cut the meshes until the grasshopper hung to the web by its ropes, like a beef hung up to cool.

"If she has good luck in taking fresh catches," Uncle John informed, "she will never touch the grasshopper again. But instinct warns her to keep the carcass as a precautionary measure. I have been told that the good housekeepers among the spiders go over their webs each morning, cutting down all meat that is not perfectly fresh, and carefully mending the rents made in the trap."

Now that their attention had been called to the matter, the children noted other shrouded masses of various size hanging here and there about the web, and Tommy's quick eyes soon spied a small spider apparently feeding upon one of these forms. "Look," he exclaimed, pointing it out excitedly, "there is one of the lady's children!"

"Not at all," averred Uncle John. "It never does to jump to conclusions, my boy. That spider is every whit as old as my lady. She is a guest in the household, a pensioner on the banded spider's bounty. A commensal spider she is called. That odd little vase-shaped sac just

here," and he went nearer, and pointed with his stick, " is the egg pouch of the commensal. My lady does not suspend her egg-sac. Her babies spend the winter in their cradle; hence it must be placed where there is ample protection from the elements. She ——"

" Ha!" interrupted Tommy gleefully. " She lets the commensals know their place, doesn't she? Did you notice how fiercely she gestured toward that one which started up the web from those flags there at the left corner? Ah, the coward, look at him skedaddle!"

" There you go judging from appearances again, Tommy," his uncle admonished, laughingly. " I didn't notice, but I have my suspicions. Wait a minute; he will be back. . . . There!" A small spider, only about one-fifth as large as my lady, but banded in faint white and yellowish streaks, appeared at the moment and cautiously began to run out toward the keeper of the net; he was followed by another and yet another of the same general garb and air of timidity. But the advancing line did not get very far. No doubt my lady recognized their tread, for she turned with an imperious fling which very plainly said " Get!" And the poor fellows made haste to obey.

" Slaves, are they?" queried Alice. " She seems exceedingly high-mighty."

"No, they are suitors," advised Uncle John, "and rather poor specimens when all is said. They are indifferent spinners, and too lazy to stay long in a house of their own building. They spend their time as pensioners like the commensals.—You will note, Tommy, that the two do not look anything alike.—By and by, our haughty Madam will give up looking for a specimen worthy of her, and accept one of them for her husband. But, poor chap, his joy is likely to be short. She is exceedingly notionate and hard to please; one false step and his life pays the forfeit!

"The female spiders are even more talented mothers than they are hunters and spinners, and the banded spider is no exception to the rule. When she gets ready to make her nest, my lady will abandon her web forever, and search out a nice warm sheltered place in a grassy hummock. The nest itself is far more of a marvel than the birds' nests we were talking about the other day. It is about the size of a pigeon's egg, and looks like a balloon turned upside down. The 'neck' is cut quite short, and crowned at the top with a curious little butter-bowl arrangement, with a scalloped rim, and the corners drawn out into moorings which hold it firmly attached to the grass of its shelter. A little silky padding covers the bowl. The rest of the nest is wrapped in a heavy covering of thick white satin, often curi-

ously adorned with ribbons, and embroidery designs done in black or brown.

"This satiny covering is perfectly water-proof, and as hard to puncture as parchment. But when once we do get our pocket-knife through it, and rip up the side, lo! beneath it we find another silken wrapping, this time of a reddish hue, and so fluffed and puffed out that we recognize it at once as an extra fine wadding. It looks much like that which Auntie used in making Grandfather's padded silk dressing-gown a few days ago. We readily recognize its purpose: it is to serve as a warm comforter for the little spiderlings, when the winds howl and old Winter does his worst.

"The eggs are suspended from the center of the quilt, in a curious little satin pocket, which is round at the bottom and square at the top, and fitted with a tight little padded lid. The eggs themselves are like small orange-colored beads, so tiny that some five hundred or more of them are glued together into a little lump about the size of a pea. The whole nursery—nest, comforter, pocket and eggs—can only be equaled for uniqueness by that of members of the same tribe, the Argiopes or Garden Spiders.

"Just think what a wonderful silk factory these spiders run! With the simple equipment of their hind legs and three pairs of spinnerets

they produce at their pleasure silken rope, satin, felt, wadding, and ribbon, and then ornament the whole with an embroidery design! How do they do it? Examination of the spinneret does not altogether answer the query, though it does explain in a measure the mechanical part. The spinnerets are small finger forms with tiny sieve-like holes distributed over their surface. These holes are in truth little tubes, and the large female spiders have as many as a hundred of these little spinning tubes on each spinneret. The tubes are not all alike; different kinds of tubes produce different kinds of silk. But how does the little worker control her machinery? What magic power in the little insignificant-looking wedge-shaped head enables her to turn out first one intricate pattern, then another? How does she produce just the colors she desires? 'I see the results,' says Fabre, who knew more about insects than any one else has ever learned, 'but I do not understand the machinery, and still less the process. It beats me altogether.'

"After the nest is finished, the banded spider moves aimlessly away without a backward glance. She has used up the very last ounce of her energy, and she is content to leave the result of her efforts to time. Small good it would do her to return to her web, even if she remembered its location. Her silk is all gone. She has not the

strength to manufacture more, and so would be utterly unable to bind any prey which drifted into her net. Besides she is not hungry. Her rapacious appetite has failed her utterly, and, in short, she has so little interest in things in general that she languishes around for a few days and then dies.

"This, I may add, is not the way of all spiders. A few species carry their egg-sacs about with them continually, guarding them jealously, and later rear up the spiderlings in the way they should go. We shall probably meet some of this clan later. Just now we must keep tab on the banded spider's silken balloon. All winter it is well-protected in its lowly grassy hummock, held close to the bosom of Mother Earth, and perchance hidden for the better part of the time beneath a blanket of snow. No matter whether the winter be mild or severe, the eggs are safe and snug in their warm pocket. In March the spiderlings begin to hatch out, and then follows a perfectly dreadful time while the larger ones eat the smaller, and all struggle in vain to break out of their stout little quarters. By and by the pocket does give way, and they shoot out over the comforter helter-skelter in every direction. There is more room there; hence less fighting and squabbling, and the youngsters have more time to spend pushing against the walls. But they

cannot break through. The world is not yet a safe place for little spiderlings; their mother has builded wisely and well.

"However, a day does come when the sun shines upon the satiny nest with such heat that the threads shrivel and burst. Like a ripened seed pod it splits open with a pop, and the little creatures are thrown out into the world with scant warning. They are in an awful commotion, of course, all mixed up higglety-pigglety with down in their eyes and their legs intertangled. But they manage to get free, and then what do they do? Each one mounts a weed stalk, or a hummock of earth, and begins to spin a little thread. When this gets strong enough to bear his weight, the little adventurer embarks on his extemporaneous flying-machine, and is off to see the world. Next spring I hope we shall have the good fortune to locate a band of these little aëronauts."

PROGRESSIVE TOWN BUILDERS

It was a rainy, disagreeable day, and Tommy, Max and Ruth were busily engaged in writing down the names of North American animals, Aunt Ruth having offered a prize of fifty cents to the one who had the longest list. Competition had been running high for the last hour, ever since the contestants, having exhausted their own knowledge, had begun to rummage in text-books and encyclopedias for help. Shortly Ruth, who had possessed herself of an old geography, stole softly to Grandfather's side.

"Tell me what these funny-looking little creatures are, Granddaddy," she begged. "There's no name under the picture."

Obligingly the old gentleman adjusted his glasses, and then, having forgotten all about the contest and the necessity for replying in secret, said heartily, "They are prairie dogs, honey. When I was a boy about the size of Tommy, there was a colony of the little rascals not far from our house, and I came to know the little chaps pretty well. Shall I tell you about them?"

"Uh-huh, please," Ruth returned, promptly

abandoning book and list, and dragging up a little stool that she might sit at the old gentleman's feet, with her arms on his knees.

"'Dog town,' we called their quarters," began Mr. Dayton smiling, "and I liked nothing better than to loaf around down there half a day at a time. At first, the little dogs were terribly suspicious of me; the moment I came in sight the sentinels would sound their sharp yelp, like the shrill bark of an excited little rat-terrier, and whisk! into their holes would go every dog in town. I would sit down quietly and remain very still. By and by the sentinels themselves would venture out cautiously and take up their stands on their lookout posts, which were the roofs of their houses. How warily they watched me! If I *would* insist on staying, they must, perforce, stay on their beat, but it was some time before they became convinced of my social intent, and sounded their funny little 'All's well!' call, which notified the colony that it would be safe to come out and resume matters. In the end, I had a number of very good friends in the lot, and I was warm in their defense whenever the neighbors termed them little nuisances and berated them for their pilfering in the gardens. So greatly did the tribe increase, however, that at last they did become a real pest, and the colony was poisoned by order of the city authorities. I nearly cried

my eyes out, and begged hard to save even one, but the law was relentless.

" Prairie dogs are the cutest and most playful little creatures imaginable. They are not real dogs, as you can tell by their picture. They are the connecting link between the marmots and the squirrels, and they have all of the latter's pretty ways. The dog town I knew covered about an acre, but in the dry, barren lands of western Texas, I am told, their colonies often run into neighborhoods all of fifty miles in length. Each mound marks the home of a dog family. Always there is a father and mother and generally a brood of young children.

" The dogs do not live in the mounds any more than the ants live in their hills. The mounds are a system of clever earthworks which serve two very important purposes: first for lookouts, as I have mentioned, and second as little hillocks to keep the water from running into their burrows, when the plains are flooded during the rainy season. The entrance is always in the side of the mound, and the long, rather steep, sloping hall often runs twelve or fifteen feet before the family quarters are reached. These run off at a sharp turn from the hall, and are fair-sized rooms, all on a level with one another. Besides the living-room and nursery, there are storerooms and a sort of cesspool where the refuse is dumped.

"Prairie dogs are clever at surveying. Never by any chance do two burrows run together underground. Usually their mounds are thrown up about eighteen feet apart, and their towns are laid out carefully with reference to streets, alleys, and playgrounds. Moreover, these little citizens have officers which correspond to our city and town officials. The sentinels are the policemen, and there is always a 'mayor' or 'Big Dog,' who looks after the general affairs of the place. I've watched him many a time sitting before his door in august state, passing out orders which were obeyed with a truly refreshing promptness and dispatch. No sentinels are more trustworthy than the pickets of 'dog town.' It is difficult to get near enough to a colony to shoot one of the little citizens. Nor does an enemy of any kind ever manage to get in unawares.

"The badger, the black-footed ferret, and the rattlesnake are his worst enemies. Against the two former there is no redress, as the badger can easily dig into a burrow and eat up the helpless family; while the ferret, of course, can go anywhere the dogs can. When a rattlesnake appears, the sentinels sound a general call to arms. The little dogs approach warily, and if the creature is seen to go down a hole, they pitch in with a will and shovel dirt into the entrance, packing it solidly with their noses, and thereby often en-

tombing the rattler forever. As a rule, however, the snakes content themselves by hiding in the grass, and picking off the puppies when they come out to frolic around. This is the method also of the coyotes, hawks, and owls, who find a dog town the most profitable of hunting-grounds.

"Another enemy persists in living in their homes with them, much as the flies and spiders do with us, only this pest of the prairie dogs is larger and more impossible to control. It is the burrowing owl. Go to any western dog town and you may see scores of these peculiar birds scattered about. They are not very shy, but if you startle one into flight it slips away noiselessly, as do all owls, owing to their extremely downy plumage. If you wound or catch one, it gives out a harsh scream. Their call note sounds like that of the cuckoo, and may readily be mistaken for it. Living among the dogs, they have naturally caught some of their ways, and they often give out a peculiar squeal, which is the best they can do toward a bark. They are very sociable and chuckle and chatter about with one another continually. They eat lizards, grasshoppers and insects of all kinds, and if they stopped at that they might be the real friends of the prairie dogs. But alas! the owls often regale themselves with the puppies of their hosts. Were it possible to

do so, there is no doubt that dog town would thankfully rid itself of the pest."

"What do the dogs themselves eat?" queried Tommy interestedly, he and Max, like Ruth, having abandoned their occupation at the very beginning of Grandfather's tale.

"Grass and herbage—alfalfa, if they can get it, grains of various kinds, peas, lettuce, and almost any kind of garden stuff. As they are day animals, scouting for food is dangerous, and often when they have exhausted the resources close at hand, they will build a new town nearer the sources of supply, rather than expose themselves to the dangers of long journeys. Like the desert animals and others whose lives are spent in dry regions, the prairie dogs never drink at all. Long ago, people thought that they dug pits deep into the earth to reach water; now we know that this is not true. Early in the morning and just before dusk is the time selected by the foragers to secure their meals and bring in supplies. The prairie dogs neither hole up nor hibernate, as do their kin the squirrels and woodchucks. They come out every pleasant day all winter long.

"Indeed, I imagine the prairie dogs would just about die if they had to spend many days in solitude! They are the most sociable little folks imaginable. I have seen them sitting on their mounds all over the town, wagging their tails

from side to side, yelping back and forth at one another cheerfully, apparently having the jolliest kind of a visit. More than this they often pay calls! I've seen them out many a time. One little madam, or perhaps the master, will come out of the house and go down the street a little way, perhaps even down several streets or across an alley, and stop at the home of some friend. The little householder delightedly barks a welcome, and invites the caller to be seated. After passing the time of day in various little squeals and barks the caller rises to go, and the friend accompanies him on to the next 'house.' This may be some little distance. Again a happy time is enjoyed, and the host or hostess, perhaps both, joins the party when they set out. Often the number is increased to six or eight before the party breaks up and they all go their several ways home. If a sentinel sounds his shrill whistle while they are en route, they all pop into the nearest entrance at hand.

"Few creatures exhibit more varied interests and human-like activities than do the citizens of a dog town. Everywhere there is movement, barking and chattering. The puppies play in the streets and parks, and there is joy and happiness everywhere, so long as the watchful sentinels see no cause for alarm. But let them catch even a suspicion of trouble, and there is a sharp note of

warning, a wild scramble and whirl of dust, and presto! all that is to be seen about the place are a few unafraid owls sitting here and yonder in their funny postures of bravado."

AN INSECT TAILOR

"UGH!" shivered Alice. "How *can* you handle that horrid thing, Tommy? It gives me the creeps!"

"That's because you don't know anything about it, Miss!" retorted her brother. "In the first place this is not *a horrid thing;* it's an insect tailor, and a decidedly clever one, too. For it not only sews a seam much neater than you can do; it makes a clever little coat to sleep in, and manufactures its own thread to do it with. Uncle John has just been telling me all about it."

"You said an *insect* tailor," Alice commented, coming nearer and regarding the object with awakening interest. "Surely caterpillars are not insects?"

"That's just the question I raised," smiled Tommy, "and Uncle John showed me the proof. Scientists say that all creatures that are made up of thirteen rings are insects. Well, count the rings yourself. . . . You get thirteen all right, don't you? Again, all insects have six legs. This fellow looks as if he had a good many

more than that, doesn't he? But look at them: they are not all alike. Only the first three pairs are jointed and have claws at their tips; the rest are merely tiny pads provided with funny little hooks. So only the first six are real legs. The rest are called claspers, and no really, truly insect has these. But the caterpillar cannot be expected to come up to form in every way; because you know it is only a baby. It is the larva of either the butterfly or the moth. Some day when it has eaten its fill and got its full growth, it will go into a pupa state and shortly turn into a true winged insect.

"Uncle John says that lots of the caterpillars are excellent tailors; but the two that do the finest work are the caterpillar of a moth belonging to the Tineæ tribe and the caterpillar of the American Tortoise Shell Butterfly. This is a butterfly baby that I have, and I am going to put him in my biggest jar and watch him make a coat."

"How soon will he be ready to go at it?" Alice demanded, eagerly. "I would love to watch him, too. But I must get my work out of the way first."

"Take your time," advised the lad sagely. "He will have to get used to his quarters first. I doubt if he is ready to do anything before afternoon. I'll keep an eye on him and let you know the minute he unfolds his pattern."

It was two o'clock before the summons came, and Alice found Tommy and Max fairly holding their breath in pleased anticipation before the large, roomy jar, which held a bunch of leafy twigs and the busy little tailor. Moreover, the latter had just begun to cut into his "cloth," which was, of course, one of the nice green leaves. Nor was he bothering anything at all about a pattern! With his strong jaws and sharp little teeth, he slashed straighter across the leaf than either of the children could have done offhand with the best pair of scissors on the place.

"There isn't even an awkward notch," murmured Tommy, admiringly. "His line is as straight as though he had followed a mark previously chalked off with a ruler, and of course he did nothing of that sort. I was right here all the time, and he never even sighted the line before he began to cut!"

"Hi! see what he has done now!" Max ejaculated excitedly.

With a quick movement of his unique little scissors, the industrious tailor had shaped his coat by cutting out a triangular notch, thus making two little flaps that were ready to turn down and fasten beneath the stem. And, marvel of marvels! without a pattern, or hint of any kind for guidance, the two pieces were cut exactly the same size and shape. They fitted together per-

fectly, and the outside of the garment was then ready to stitch.

Imagine a caterpillar sewing a seam! That was about all the interested children could do, for though they saw the fuzzy body moving slowly down the length of the "garment," they could not get the ins and outs of the process. Moreover, when the job was completed, it needed a microscope to detect the seam! Clever little tailor! How had he managed? Whence came his thread?

"He did not spin it, that is certain," declared Alice. "A caterpillar does not have spinnerets like a spider."

"I know," cried Max. "Don't you remember the pine processionaries? They dribbled their thread from their mouths. No doubt this fellow did the same."

"To be sure," affirmed Tommy. "At the back of his jaws is a sort of little flat lip, through which comes a very fine tube. The 'silk factory' is located at the other end of this tube. It is a complex piece of machinery, and I doubt if even the caterpillar himself knows how it works! He doesn't need to, so long as it never fails to produce the goods."

"Funny sort of a coat, isn't it?" murmured Alice, her dressmaker's eye quite taken with the trim little cylinder. "What is he about now? Ah, look! he is fastening it skillfully back under

the uncut part of the leaf. Clever idea, too. Not one in a dozen would ever think of looking on the under surface of the mutilated leaf to find the missing pieces. It is a perfectly safe nook, and neither rain nor dew can touch it, for the awning above is thoroughly moisture proof. Surely no more ingenious cradle could be fashioned!"

She was turning away as she finished speaking, quite satisfied that the exhibition was over. But Tommy caught her arm.

"It is not done yet," he advised. "You wouldn't think you had it finished if you were doing the job, would you? Every nice warm coat has to have a lining, and the caterpillar is a first class tailor. I don't imagine he will quit until the garment is finished up right and proper."

Sure enough! After a brief rest, the little craftsman went at the business of lining with a will, and now his thread factory turned out a nice soft silk which made the finest sheet wadding possible to be found anywhere. It was fitted in close and snug, and there was no doubt but that the little tailor would be as warm as toast whenever he took refuge inside the little coat.

"He intends it for use only at night and when it is damp and rainy," Tommy informed. "When he is ready for the grand change he will seek some perpendicular support, and, after making himself fast about the middle with a girdle of

silk, will cast his caterpillar skin and turn into a chrysalis. Do you know the difference between a cocoon and a chrysalis? Uncle John explained it very simply: a cocoon is woven of silk, a chrysalis is a hard little case. The time the caterpillar remains in the pupa state varies anywhere from two days to two years, all depending on the species. Many kinds of butterflies winter in the chrysalis."

"Is there any easy way of distinguishing moth and butterfly caterpillars?" Alice wanted to know.

"Not absolutely. Moth caterpillars are nearly always fuzzy; butterfly caterpillars are smooth and naked. But there are some exceptions. Uncle John and I were caterpillar hunting this morning. See, here are some others that I found," and Tommy led the way to another collection of jars. "This black spiny-covered specimen is an exception to the rule just mentioned; for it is the offspring of the Mourning Cloak butterfly. You all know her. She is purplish brown, with wings bordered by yellow, brown, and blue. She is the first butterfly to be seen in the springtime, because she hibernates like the bears and woodchucks do. But she is a light sleeper, and in the south she often comes out and sails around during specially mild days in midwinter.

"This brown-headed, green-colored fellow, all spotted with blue dots, is the caterpillar of the Tiger Swallow-tail. I think you know her, too. She has yellow wings banded with black, and marked by a row of yellow spots along the marginal border. Like all the swallow-tails (there are about 850 kinds), she has funny little projections like a swallow's tail on each of her hind wings. This baby is a spleeny fellow. See!" and Tommy punched him smartly with his finger; whereupon a pair of soft orange-colored horns, like the letter *y* in shape, were thrust out from a slit in the fore part of the creature's body, and there was a strong, disagreeable odor noticeable at the same time.

"He may be able to scare some folks with his silly weapons," laughed Max. "Look at the pair of yellow eye spots with black centers near his head. Do you suppose he can see anything?"

Tommy shook his head, and waved his hand grandly, like a showman: "The next specimen, ladies and gentlemen," he declaimed pompously, "is the child of the Monarch butterfly, alias the haunter of the milkweed patch. Observe his black, white, and yellow bands carefully. Some day he will turn into a bright green, gold-spotted chrysalis. Later still he will become one of the much-talked-of milkweed butterflies—a splendid reddish-brown creature, with wing borders and

veins broadly black, having two rows of white spots on the margins. And who knows how far he may wander! The Monarch is one of the strongest flyers in the whole *Lepidoptera* clan—which means the race of butterflies and moths, you know. Specimens have been taken on vessels hundreds of miles from land. These butterflies live over the winter, but they do not hibernate, they migrate like the birds.

"Great flights of Monarchs are observed every spring, ranging from the Gulf States to Canada. The butterflies pause in passing to feed and to lay their eggs upon the young milkweed leaves. Such funny eggs, too! They look like tiny lumps of green loaf sugar. In the fall there is a return flight southward, and the butterflies eventually hide themselves away beneath the bark of trees and in sheltered places for a brief sleep. The encyclopedia says that often these butterflies light on the lee side of a tree in such numbers as to hide the foliage and give to the leaves a tint as of autumn coloring. This butterfly is provided with a scent pouch, and when enemies approach he fills their noses with an ill-smelling gas."

"My word!" murmured Alice, admiringly. "And here some of us have been thinking that fighting with gas was an invention of the World War!"

"I hope to make a real collection of butterfly

caterpillars before the summer is over," Tommy continued. " By the way, Daddy says he hopes I'll specialize on cabbage caterpillars! He is battling with a whole army of them, as usual at this time of year. These other ' finds ' are moth babies, as you see. This little fellow in its coat of brown and black is called the woolly bear. It is the child of the Isabella tiger moth. When disturbed it promptly curls up and feigns death —like our 'possum friend.

" This second member of the moth tribe is the yellow bear. After changing his clothes several times, he will be one of those fellows that Grandmother calls the ' braided ' caterpillar. You know what he is like: six rows on his back are tufts of hair which are braided as fine as you please. Grandmother says doubtless their mothers get them up that way for school! If you badger him, his hair unbraids, and each separate tuft stands up stiff and straight. My, but he does look fierce! ' Dog ' caterpillar would be a better name for him, I think.

" My third specimen is the hickory-tiger caterpillar. He is common enough among the nut trees, and Uncle John says he has even seen him in the apple orchard. He is easily recognized by his black and white markings. See! the black, hairy tufts are found along the middle of the back, and at either side are the white ones. Near

the head is an exceptionally long tuft of black hairs, and long white hairs stick over his head like a horse's fore-top.

"Butterflies and moths do considerable good distributing pollen, and thus help to form seeds. But their babies are all such gluttons that they do no end of harm in destroying the foliage of fruit and shade trees, besides ruining vegetables and grain. Caterpillars are one insect that we should set our heels on whenever we come near them, Uncle John says. But, I beg you, fetch me the *first* one of every kind you find!"

"You'll have to take care not to let your specimens escape," warned Alice. "Remember the gypsy moths which got away from that Massachusetts professor, and have since cost the state thousands of dollars in fighting them, to say nothing of the loss caused by their depredations."

"Say," queried Max, abruptly, "do you know how to distinguish butterflies from moths?"

"Yes," Tommy returned, "there are three general rules, but you've got to look out for exceptions. *First:* Butterflies fly by day, and moths usually only at night. The humming-bird or hawk moth is an exception. You have all seen it around the trumpet flowers just about dusk, and on cloudy days. Indeed, all the characteristics of this moth are an exception from start to finish. In babyhood it is the big ugly *naked*

green tomato-worm, with white stripes slanted along its sides, and a horn upon its tail. Instead of pupating like other moths in a silken cocoon, it goes into the ground and spends the winter in a funny brown chrysalis. You all know it. We often plow it up in the spring when we are getting the garden ready. It looks like a ringed worm sticking out of an odd-handled case."

"I know," interrupted Max, "we always call it 'the worm with a handle.'"

"*Second:*" continued Tommy, returning like a lawyer to his briefs. "When resting, the wings of a butterfly are held vertical over its back; while a moth at rest spreads its wings out flat, or holds them folded against its body at the sides.

"*Third:*—and this is the best rule of all—The feelers of the butterflies are long and thread-like, with little swollen knobs on the ends. Each one looks like a tiny club with a thread handle. The feelers of the moth either taper to a fine point, or are feathered throughout. The American silkworm is an example of the feathered-feeler moths. The hawk moth has very long feelers, thickest at the center, and hooked at the end, a further continuance of its exceptions, you see."

"Goodness me," exclaimed Alice, as Tommy turned to replace his specimens, "there goes the supper bell! Wasn't it lucky it was Mabel's turn to get it? I had no idea of the time! Moths and

butterflies *are* interesting; but, Tommy, I still maintain that caterpillars are horrid creatures, tailor or no tailor!"

SOME TIMBER CUTTERS

"LISTEN to this, folks," called Mr. Dayton, from the depths of a voluminous newspaper; "here's some data on one of Nature's craftsmen, a skilled wood cutter and mason, that is most astonishing." And he proceeded to read a special to the *Post-Dispatch,* as follows:

"'Ellensburg, Washington.—A large number of beavers have executed an extraordinary engineering feat in the Cascade Mountains, forty miles from here, by building a dam twelve feet high and more than a quarter mile in length. Seven beaver houses at the center of the dam are of large proportions, one being fifteen feet high and thirty feet across at the bottom. These are unusually spacious for beaver homes, but according to Indians, were made so tall because of floods which are sure to come in the spring thaw. Evidently the beavers were looking for the long, cold winter being experienced in the Northwest, as large quantities of green wood for food were found in or near the houses.

"'In building the great dam, the ingenuity of the most intelligent of the animals must have been taxed, for logs over a foot thick were carefully balanced between two large rocks at the point of greatest pressure. Not much water was held in by this log and rock wall, but in the freshet season

two months hence an enormous amount would be impounded. So great a menace did this huge dam present that the State Commission of game gave the district Game Warden permission to destroy the colony. Over two hundred beavers of all sizes were trapped and the pelts sold at auction. Under the protective laws, beavers in all parts of the Northwest multiply rapidly, and their dams often disturb the proper flow of water feeding irrigation canals.' "

" It is good to know that nowadays official permission is necessary before the little creatures can be slain," commented Auntie. " They have been so mercilessly persecuted in the past, not only for their fur but for their flesh as well. In the beginning of this century, more than two hundred thousand skins were shipped to foreign lands each year. The Indians and Canucks are very fond of beaver meat. It is said to taste something like pork, but it is more oily and fragrant."

" Like 'possum, I imagine," remarked Uncle John, " it takes a person with a considerable liking for wild meat to enjoy it."

" Beavers are black, aren't they?" queried Alice. " All the beaver fur I remember seeing has been confined to hats."

" Chestnut brown is the usual color, I believe," replied Uncle John, " though there are often black and spotted specimens, and now and then there is a pure white one. The beaver is a rodent;

that is he belongs to the rat family, and is about the size of Daddy Thornton's rat-terrier. He has a broad head, small eyes, a blunt nose, and short, rounded ears. There are five toes on each foot, those on the hind feet being webbed. His teeth are a bright orange color and as sharp as chisels. His tail is about eleven inches long, broad and flat and covered with scales. He uses it to prop himself when he stands on his hind legs. In the water it is the rudder which directs his course, and he also uses it as a paddle. He is a graceful and powerful swimmer, and never by any chance travels by land unless forced to do so. His tail is, in fact, one of his most useful members. Folks used to say that he used it as a trowel. This is not true, but he does slap it on the ground sharply as a warning of danger. One slap, and you should see the others scatter!

"All told, the beaver is a very remarkable creature, and a more clever and industrious little craftsman than he would be hard to find. He lives in a burrow during the summer and in lodges in winter. Always the entrance to the home is under water, and it must be down deep enough so that there is no danger of its being stopped up by ice. This is the real reason that beavers build dams. Ordinarily the site selected by them is not a stream of sufficient depth to guarantee safety from the advances of the ice

king. So the beaver, like the wise little engineer that he is, builds a dam to keep back the water and thus raise it to the required depth. These dams, as the paper has just stated, are often massive affairs, and in their construction the little animals often show great engineering ability.

"The beavers live in colonies, you know; so that what looks like a gigantic undertaking for so small an animal is not such a terrible problem when two hundred or more go at it. Indeed, a dam ten feet thick and three hundred feet in length is often constructed in what seems an incredibly short time. The first job, of course, is to fell the trees necessary for the log part. Six or eight of the workmen chiseling with might and main on a tree is an interesting sight! So sharp are their teeth and so strong their jaws that even large trees cannot long stand against their tireless onslaught. Moreover, they know enough to fell their tree so that it falls into the water where they can handle it, and they always cut it far enough up-stream to give them plenty of opportunity to swing it into the position they want it. An instance is on record of a poplar tree, nine feet in circumference, that was felled by the beavers on the upper Missouri. Doubtless among the beaver colonies of the Northwest, where great trees are the rule, this feat is often exceeded.

"After enough trees have been interlocked

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THE BEAVER AT WORK

across the stream, the chinks are filled with branches, sticks, stones, grasses, and mud, until the dam is firmly wedged in place. It is not so tight, however, but that the water trickles through it instead of running over the top. The beavers walk on their hind legs and carry the mud from the bottom of the stream in their fore-paws, holding it pressed against their chests with the aid of their chins. They work only in the late evening and at night, and while there is no 'boss' in charge, each mason is so apt in planning and executing that not a single move seems to be wasted. As the industrious creatures are always adding material to their dam, so that it will not become weakened and go down in a freshet, it often happens that in cases where a dam has stood for some years its dimensions become very large and thick. Shrubs and trees sprout upon it, and it has every appearance of a green hedge stretching across the water. A large proportion of the marshy ponds and bogs of our country are supposed to owe their origin to the constructive energy of the beavers. Who knows, perhaps some of our west marsh may have been built by a colony of beavers? In truth, it is highly probable. I have even thought some of trying to found a colony there again. Eh? What do you say, boys? Wouldn't it be great fun to watch them getting down to business?"

"It certainly would!" "Do, Uncle John!" came from the boys.

"While several families live in one 'lodge,' each has its own quarters and private door, and there is no door of communication between the various homes. The beds are built along the wall, of moss, grass, and small twigs. The center of the room is left empty and is kept very clean. Beavers lived originally in the watered woodlands all over North America and in the Old World, being most plentiful about the wild wooded lakes of our northern states and Canada, and in Norway and Siberia. The wholesale destruction of the beavers has nearly wiped them out of their old haunts, but now thanks to protective laws they are slowly being won back in many parts, particularly in the swampy forest headwaters about the Mississippi and in northern Maine. They take quite well to confinement, and are to be found flourishing in colonies in zoölogical gardens and parks in New York, Washington, and other large cities. According to Woods, beavers confined in a room have been known to build dams across their quarters, using brushes, books, fire-irons, boots, and anything else they could find, proving plainly that their marvelous building ingenuity is not founded on reason but on instinct.

"Usually a litter of four baby beavers are pro-

duced at a birth. They live at home for two years. Then there are a number of beaver weddings, and each young couple strikes out for an unoccupied part of the woodland and founds a new colony. Their first labor is to dig a burrow in the bank, starting from an entrance at the bottom of the stream. Here they make their home for a few years, until the increase in numbers gives extra hands for more pretentious building; then the old burrow serves for a variety of purposes, not the least being for a refuge in time of danger. Occasionally an old 'bach' is found living glum and morose away off by himself!

"Beavers are close kin to the squirrels, and, like them, sit upon their haunches a great deal, holding their food in their fore-paws and otherwise using these 'hands' very dexterously. The food of the beaver is the bark of trees, roots, and water plants. In summer they eat plentifully of berries, leaves and water-lilies. When tamed and cared for by man, they like bread and milk, sugar, fruits and rice, and are said to be very fond of plum pudding. In the fall they lay up stores for winter by cutting a number of green branches and sinking them in the water in their 'dooryard,' weighting them down firmly by piling stones on the heap. Whenever a beaver feels the pangs of hunger in midwinter, he goes to the storeheap and drags out enough 'greens'

to make a meal. The Indians foretell the length of winter by the size of the beavers' store. One authority cites a certain colony of beavers which gathered seven hundred and thirty-two sapling aspens and several hundred willows for the coming winter, forming a pile over three feet deep and one hundred and twenty-four feet in circumference. Roots of water-lilies and other aquatic plants are also stored to a considerable extent.

"Of course, in the case of a large beaver colony, the shrubs and trees along the water's edge are in time destroyed. Fresh bark for their food supplies needs must be had, however, and the little people meet the demand most ingeniously. Going above their dam, they begin the construction of an extensive canal system, and in a few years' time their canals penetrate the woodland in every direction. These are often dredged to a considerable depth, and range from two to three feet in width and are often one hundred yards in length. The beavers take pains to keep them free and open, and thus, while the rest of the 'pond' becomes gradually grown up with water plants, the canals form an avenue along which new lodges and burrows are placed, and where food and building materials may be freely floated down to the main channel."

A QUEER HOUSE BUILDER

"See here, Uncle John," begged Tommy, "please read this riddle for me. Grandmother says it is an oak apple; I knew that already. I've cut several open, and there's nothing but a spongy growth inside. What makes them, and what good are they?"

"Hmm!" murmured Uncle John, reaching for the specimen. "First, let me show you that your investigations were not complete enough." With his knife he cut deftly into the "apple," and pushing aside the spongy matter disclosed a hard little kernel about the size of a pea. "See!" he said, "here is a tenant. Inside this cradle is a little white grub, the child of one of the many insect foes of the oak. In the autumn the oak apple falls with the leaves, and lies safe and snug among them until spring, when the little grub that was comes forth transformed into a gall-fly like its mother. It is a small, dark-colored, four-winged fly, and, after a brief wedding journey, the female sets out to lay her eggs on the oak leaves just as her mother before her has done.

"Of all the queer eggs that of the gall-fly is the queerest! It is a slender little affair, with a

sort of long petiole or footstalk six to ten times the length of the egg itself. It is jabbed into the leaf by the gall-fly's long, curious-shaped, egg-laying tool, and by some means not clearly understood the misused leaf is made to transform itself into a nursery for the gall-fly baby. Once upon a time it was thought that a poisonous liquid was deposited with the egg, but presently it was noted that no change was to be observed in the leaf until after the egg hatched. Therefore, now it is supposed that the larva itself secretes a liquid which causes the abnormal growth. This liquid is not capable of producing an entirely foreign growth unaided, you understand; it simply stimulates the cells which are the most active in growing and subdividing, and the plant does the rest.

"Galls are queer things, and show a wide range of form. Moreover, all galls are not made by gall-flies. Some beetles and caterpillars, a few Chalcis flies, and certain mites and scale insects produce galls. But usually when galls are mentioned it is the product of the gall-flies that is thought of; perhaps because for so many years the galls of the dyer's oak, a product of the gall-fly, were imported in large numbers to be used in the manufacture of ink.

"Gall-flies of every species seem to be particularly fond of the oak. They pierce its shoots, its twigs and leaf-stalks, and even the mid-rib of

the leaf. One tribe which visits the scarlet and black-jack oaks have a decided hand in shaping the tree. Their nursery is in the wood of a branch. Outside this nursery is a great black knot deforming the whole limb; within is a mass of cells with a little worm living in each. One may easily sight dozens of such nurseries down in the wood-lot, and all but the initiated will pass them by totally unsuspecting their real character.

"One species of gall-fly attacks the rose-bushes, and works all sorts of wonders. For example, often on a smooth stemmed rose we find a queer wart or gall that is covered with thorns. Every part of the rose is affected by the various gall-flies which frequent it—root, stem, leaves, all are distorted with their greenish swellings, which turn to shades of red and yellow and finally to brown as the season advances. When fully matured the spiny rose gall just mentioned is as large as a cockleburr, but round in shape, and most thoroughly protected by its defensive armor of rigid thorns. Inside is a full-grown larva, perhaps one-sixth of an inch in length. The gall is now dead, but it serves the little footless, worm-like creature for shelter until spring, when an active little gall-fly emerges from the little 'house' through a round hole which it has gnawed in one side.

"When you once get to looking for galls you

will be amazed to find them everywhere, not only on the oaks and rose-bushes, but on the maples and lindens of our lawns, on the hickories and willows of our woods and hedges, on the golden-rod of the fields, and indeed on very many of the plants all about us. The galls of the golden-rod, however, are produced by a Tineid moth; and most of those on other low plants and shrubs are the work of lice, mites and beetles. True galls, that is those made by the gall-flies, differ from each other vastly more than do the species of little craftsmen that dwell in them. But whether burr, berry, wart, cone, 'gouty,' or apple be their shape, all are inhabited. The same kind of fly will produce different kinds of galls on different kinds of plants; likewise, too, different kinds of flies will produce different kinds of galls on the same plant. Always, however, each species of gall-fly infests a particular part of the plant, such as the root, leaf or stem, and that part alone; and its galls are always as near alike as two peas. On seeing a gall, then, we can be practically sure what little craftsman started the house building. But, if we hatch and rear the little grub that is installed therein, we are not always sure to get a specimen similar to the one we are expecting. And why? Because the same trick of fate which works changelings in other cradles is frequently effected here. Ofttimes the

guest gall-fly comes along and lays her egg side by side with the true gall, and the two babies are reared in one cradle; again a parasitic gall-fly deposits a companion egg and the little parasite when it hatches proceeds to feed upon the true gall baby. Another point, the individual hatched may be a sure enough gall-fly, but instead of looking like its parent, it resembles its grandparent, which was another creature altogether. The subject of gall-fly generations is like a Chinese puzzle. One may have wings, another be wingless; one may be all females, another of both males and females; we see their case paralleled in the undersea world by the hydroids and jellyfishes.

"Strangely enough, or perhaps, knowing Mother Nature, we had better say *as is to be expected,* the little gall nurseries all have their protective features. Some galls exude sweet juices and thus attract the honey-making ants who at once establish a guard about it, and thenceforth protect the rich stores with their lives if need be. Other galls are covered with sticky hairs which entrap would-be marauders. Again the spongy growth is too thick to be readily broken, or the hollow chamber is so large that a groping tongue cannot readily discover the small occupant. Or perchance, as in the oak apple here, the baby is further safeguarded by being hidden away in a wooden cradle; some galls even have hard stony

cradles. The pine-cone galls are sufficiently protected by their scales. Other galls are exempt by reason of their bitter tannin, or because of a protective coloring which safely hides them from all but the very sharpest eyes. Various insects, creepers and titmice, and the squirrels are the chief enemies of the gall babies. The birds and squirrels tear open the houses to get the little tenants. The insects feed upon the rich tissues of which the house is formed, and even penetrate to the well-stocked pantry which the inmate itself fills by industriously secreting a sort of juicy ferment which changes the stored starch into sugar.

"Often in hunting for galls you will come upon strange wens and tumors on certain trees, particularly on the birches and hackberries, which seem too large to harbor even a host of gall-fly babies such as are sometimes found in woody growths. Investigation will show that these strange woody deformities, with their divers little twigs twisting helter-skelter in every direction, are caused by a peculiar fungus. Before this was understood, people stood in awe of them. They called them witches' brooms, and many queer and creepy stories were told concerning them. In Germany, the name thunder-besoms was applied to these queer tufts of twigs. Similar growths on the rose-bushes are often termed elf-rods even to this day."

FAMOUS SPINNERS

"You know," Auntie observed, as she deftly hemmed Mabel's new silk dress with dainty, even stitches, "when we first began to talk about Nature's craftsmen, it was remarked that man could make almost anything in the way of machinery, and could manufacture almost anything he pleased; and yet there is one thing he cannot do. No human being can make a single yard of natural silk. To be sure, some manufacturers have succeeded in turning out very good imitations, but their silk is much thicker and heavier than the real article.

"It is to the skill of the silkworm or, strictly speaking, to the silk *caterpillar* that we are indebted for real silk. The Chinese who discovered the usefulness of these remarkable little creatures, more than four thousand years ago, are to blame for the misnomer. The industrious little silkworm is not a *worm* at all. It is a child of the Bombyx moth, and hence must of necessity be a caterpillar. For a caterpillar by and by passes into winged life; a worm does not. But it is too late now to change the name, however wrongly

placed it may be. It was the Empress Si-Ling-Chi who discovered the secret of making cloth from the silk of the silkworms, in the reign of the third Emperor of China, 2,700 years before Christ was born. For centuries the Chinese guarded the secret with jealous care, and the work of rearing the worms was considered fitting labor for queens and the nobly born. The penalty for carrying the eggs out of China was death."

"I know," said Mabel. "I was reading just the other day how two Persian monks managed to learn the secret, and finally escaped to their own realm with a quantity of silkworm eggs safe in the hollow handle of a bamboo cane. Shortly, then, the exacting demands of the Oriental silk merchants were broken; for the industry once it had escaped bounds spread like wild-fire. Silk was first manufactured in England in the reign of Edward III, and for long years 'the mystery of the silkwomen' was protected by an Act of Parliament. France, who later came to excel in silk-making, did not establish her silk industries until 1564."

"Tell us about the little craftsmen themselves, Auntie," Tommy requested, bobbing up from a corner where he had been poring over a book. "I wonder, could I grow 'em?"

"To be sure you could," Miss Merryhew re-

turned promptly. "But the work is very exacting, and requires some one in almost constant attendance. To begin with, suppose you were to buy an ounce of silkworm eggs. How many of the tiny things do you suppose you would get? Around forty thousand. Imagine such a number of eggs! It would take you some time to count that number, would it not? You would probably have the best success hatching the eggs in an incubator. The temperature should be about fifty degrees when the eggs are put in, and gradually raised to around seventy-three. It takes about nine days for the eggs to turn into grubs. The nearness of hatching may be noted by the whitening of the eggs.

"Now the silkworm raiser's labor begins: he must cover the eggs with sheets of coarse tulle, or with paper which has been pierced full of tiny holes. On this covering should be placed a fine sprinkling of white mulberry leaves chopped into tiny bits. As fast as the worms come out, they will crawl up on the sheet. For they are the hungriest, most voracious little babies imaginable! At first they are too tiny to eat the leaves, they merely suck the juices. But it is astonishing how much juice they can imbibe in twenty-four hours. The sheets must be changed eight or ten times during this period. As soon as the worms have climbed up on a fresh sheet, the soiled one

is removed and burned. Cleanliness and right temperature are prime features in the silkworm business. The worms are very delicate, and subject to various death-dealing diseases, chief of which is known as silkworm rot, due to a fungus growth which takes place inside the caterpillar.

" For ease in handling, the sheets of silkworms are usually placed on trays of screen-wire or wicker. Such trays allow for careful ventilation, which is another very important point. About a square yard of space will do for the little black fellows in the beginning. They are so very tiny that it would take thirty-four of them in a straight line to make an inch. In two days, however, so rapidly do they grow that double the space is required, and, by the time they are ready to spin their cocoons, sixty times as much shelf room is required. The skin is changed four times during the growth of the caterpillar,—a period of eight or nine weeks altogether. And during all this time the grower is kept on the jump, providing food, changing the sheets, and keeping the room well-ventilated and the temperature around sixty-five degrees. One person, of course, cannot begin to do all the work that is required. In China and Japan it takes the whole family: the boys to gather and chop the leaves, the girls to prepare the sheets and do the feeding, the father to keep the charcoal burning in the little braziers

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"SUPER" SILKWORMS AT WORK

that are set about to keep the room warm, and to help with the cocoons, and the mother and the girls to do the winding, spinning and weaving.

" About the only breathing space is during the moulting periods. For then the silkworms refuse to eat. But it is an anxious time for the growers; often the worms die during the moult. Poor little creatures, growing a coat isn't as easy as some would think apparently. The little worms turn yellow and hump up their bodies, crawling about restlessly at first, and then as the skin grows tighter they remain very still. By and by the old coat gets so snug that the ' cloth ' needs must give; the garment splits across the shoulders, and the worm wriggles the upper part of its body free. Soon afterwards it is out, but oh, so tired! In twenty minutes or more, however, if it is a strong specimen, it is quite rested and climbs up on the clean sheet.

" ' Yum-yum! how good fresh mulberry leaves are! ' it seems to say, and as it eats it moves its head from side to side in evident enjoyment, while the leaves disappear at a great rate. Sometimes, particularly in our own southland where the worms are coming to be grown more and more, Osage orange leaves are fed instead of the white mulberry. But worms so fed make a coarser and less valuable grade of silk. Leaves from the

black mulberry and lettuce leaves are also used sometimes. But nothing gives as good returns as the white mulberry. The red mulberry and the paper mulberry are said to be quite worthless for silkworm feeding.

"Each time the caterpillar moults it becomes paler in color, the reason being that each successive coat has fewer black hairs in its nap. When full grown, the worm is nearly three inches long and quite naked. Its color now is usually a yellowish-gray; wild varieties are much darker. All the time the worm has been growing two large glands or sacs have been forming along its sides. These sacs are the spinnerets. They open into the silkworm's mouth, for like all caterpillars these little creatures dribble their thread. For five days before the worm is ready to begin spinning its appetite is hard to satisfy. It eats every waking moment, until at last its needs are filled, when it begins to grow stupid and languid, and the grower makes haste to provide a quantity of small brush, clumps of rice straw, or arches formed of fine wood for the workers to fasten their cocoons upon. These are placed in rows about sixteen inches apart, so that the caterpillars may have ample room. Now, too, the temperature is raised about ten degrees.

"Shortly each spinner has selected a site for his silken house, and is busily engaged on the

'foundation,' which in this case is a network to hold the cocoon. One strand comes from each spinneret, and the two strands are joined together. But it is quite impossible to see how this joining is done, even with the most powerful magnifying glass. At first the spun thread is as soft as jelly, but it hardens quickly on being exposed to the air. The caterpillar seems to force the silk out by contractions of its body, and even after the network is finished and the caterpillar has begun to wind itself into a cocoon in the center, one may know that the work is still going on by a soft little sound made by the machinery of the tiny silk manufacturer. In twenty-four hours the spinner is hidden from sight, but it is still busily at work.

"For three days and nights the tiny silk factory runs without ceasing, and then behold! a beautiful light-colored silken house nearly as large as a pigeon's egg. There is no door or window. The little occupant will make a door in one end when it is ready to come out. Because the making of this door cuts the silk so that it cannot be wound, only those cocoons which are needed to provide moths for future egg laying are left to develop. A difference in the shape and size of the cocoons denotes the sex of the creature within: the females spin large plump cases, while the work of the males is much smaller, with

sharper extremities and a depression in the center.

" As soon as all ' mill ' sounds have ceased the cocoons are carefully sorted. Those which are to be unwound for silk are treated in various ways: some growers dip them in hot water or steam them, others bake them in the oven. The object is to kill the worms and to soften the gum so that the threads can be wound. The threads range from six hundred to one thousand yards in length; sometimes an especially fine one will measure twelve hundred yards. More than half a mile in length—think of it! It takes about three thousand cocoons to produce one pound of raw silk. With good luck, the grower generally realizes about one hundred pounds of cocoons from an ounce of eggs. The raw silk is wound or reeled into skeins, and in this shape is ready to be sold to silk factories, or it may be worked up at home. It takes the fiber from ninety cocoons twisted together to make a thread of sewing silk. So you see how very, very fine must be the product produced by one little silkmaker. Thousands and thousands of silkworms lived, spun, and died to provide silk enough for this dress of Mabel's.

" An interesting change, of course, takes place in the cocoons which are kept to replenish the silk grower's stock. Shortly the inmate of the silken house turns into a hard little ringed chrys-

alis. It has neither head nor feet, and the wings of the future moth are folded over the breast. It is golden-yellow at first, but gradually deepens to chestnut brown. In about three weeks' time a creamy white moth comes out. The life of one of these is brief indeed, but the females lay a host of eggs before they go—sometimes as many as four hundred each. When first laid the eggs are pale yellow and look as though they had been covered with varnish. They soon turn gray. Dainty little eggs of promise! How careful the silk grower is to save every one."

"What about wild silkworms, Auntie?" Alice wanted to know. "I saw a cocoon woven in a network such as you have described in a hazel bush last week when we were camping. I passed it by, supposing it to be the egg-sac of a spider."

"It was probably the cocoon of Madam Cecropia," informed Uncle John, who had just joined the group. "She is the largest of our American silkworms, of which we have several species. The moth herself is a beautiful grayish-brown creature marked with reddish and yellow spots and bands. Her full-grown larvæ are large green fellows handsomely decorated with six tiny coral-red knobs on the thorax and a number of blue knobs on the abdomen. They feed upon all rosaceous plants—that is all those of spreading petal type like the rose, apple, plum, bramble,

and strawberry, and upon the hickory, maple, willow, hazelnut and honey locust. The cocoon is a peculiar one, being built with double walls—a thick, wrinkled, brown paper-like outer wrapper, and inside a dainty case of silk.

"The large luna moth is another distinguished member of the silkworm clan. You know her, I believe. She is of a handsome delicate green color, with swallow-tail wings. Her cocoon is spun in several of our forest trees. She is a close kin to the yamamai, or 'oak' silkworm which is much raised in Japan. The silk of the yamamai ranks next to that of the domestic silkworm.

"The species called the American silkworm often fastens her cocoons to the leaves of our fruit and shade trees. They are formed of strong silk, which unwinds in a glossy fiber. Frequently these cocoons are to be found clinging to fallen leaves. You may know them by the chalky color of their hard gum which takes considerable heat to soften. The moth herself is a handsome buff-colored creature.

"India cultivates six of her native silkworms. China, Japan and France use every available one of theirs. England, too, has tried her hand at taming the wild ones. No doubt many of our own American spinners could be domesticated, and the quantity and quality of their silk improved by careful selection. If you want to experiment

with silkworms, Tommy, you might do something worth while in this line. A large part of our country is splendidly adapted to silk culture, and the day is coming when this is bound to become one of our leading industries."

A SKILLED CEMENT WORKER

MABEL and Alice had been busy sketching the nests of various Nature's craftsmen, and Uncle John had been called in for advice and criticism.

"Do you know," he asked, as he settled himself for a chat afterwards, "that there is a fish that constructs a nest not much different from those built by our feathered friends? It is the stickleback, a creature about four inches in length. If we go to the lakes to camp this summer, we shall be very apt to meet him.

"I say *him* because, contrary to the usual fashion among our small neighbors, it is the male which builds the nest. More than this, it is he who stands guard at all hours and carefully attends to the wants of his offspring. The female stickleback is a fickle, empty-headed creature, too fond of a good time and society generally to care for family ties. It is with reluctance that she even enters the nest long enough to lay a few eggs. Indeed, there is a good deal of the cuckoo about the female sticklebacks. They may lay in one nest to-day and another to-morrow. Usually several females deposit their eggs in one nest, and Father Stickleback is quite likely to

have a numerous family on his hands. But he is quite equal to the occasion, for, small as he is, no fish can equal him in daring and courage. He is a regular pepperpot, and fights all comers, taking no rest and giving no quarter, until his enemies are forced to flee from him.

"The stickleback is a handsome fellow and shines as if he were covered with silver tinsel. But when he loses his temper he changes color as rapidly as did the diamond in Merlin's wonderful Necklace of Truth, being first red, then pale, and then flushing a rich purple in the most surprising way. Owing to his spleen, the stickleback's life is one round of excitement, and he pays a heavy toll, for his years are few, only three or four at best."

"*Dum vivimus, vivamus,*" murmured Mabel, who liked nothing better than an opportunity to air her Latin.

"Exactly," Uncle John agreed smilingly, "the stickleback's motto could not be better phrased."

"Interpreter! *interpreter!*" Alice cried, rapping smartly with her ruler, as one demanding "author, author," at a rehearsal.

"While we live, let us live," informed Auntie, speaking softly close at hand; for Tommy had started Uncle John again by inquiring into the nature of the stickleback's craft.

"He is a cement worker, lad, of the most skilful type. His cement is a thread-like glue drawn from a special gland as it is needed. It is ideal for the purpose of cementing together bits of leaves, water plants, and grasses, to form the tiny muff-like nest, which looks very much as though it might have been fashioned by some bird. But where is the bird that would build on the sandy bottom of some lake or sluggish stream?

"The most important part of the structure is, of course, the bottom or foundation of the nest, and the stickleback goes at it with great care. He bustles about fetching material in his mouth until he has collected quite a heap. Then he begins to lay his grasses and leaves crisscross, cementing them together as they are laid. By and by, he has covered a floor space as large as desired. It looks frail. No doubt a sudden squall could easily start it from its moorings, and the stickleback takes no chances. Quietly he begins to gather tiny stones and pebbles, strewing them over the floor to hold it down. This done he proceeds to lay another floor of leaves and grass on top of the first, carefully making all fast as before. Sometimes there are three or four layers of flooring, perhaps more, each carefully weighted with rocks which are cemented tightly into their positions.

"When the floor is completed to the work-

man's entire satisfaction, work is begun on the walls. These are formed of grasses, leaves, and twigs, plentifully glued and cemented together to form a circular shape, with the central part hollowed like a muff. At one side is a nice round door; just opposite this is another opening not so large, which we may term a window, though Mr. Stickleback and his various fair guests always come out at it. Imagine continually entering your house at the door and coming out the window! The reason why in stickleback wherefores is due perhaps to their ingrained policy, 'Onward, forever onward!' They cannot waste time in turning about and retracing their path!

"Mr. Stickleback is not very particular about the outside appearance of his walls. They are, in truth, quite shaggy, but inside only the finest and softest grasses are used and the cement is 'troweled' to the smoothest possible surface. There must be nothing to hurt the delicate bodies of the young Sticklebacks. Fortunately the eggs hatch without being kept warm! Father Stickleback, energetic as he is, could never sit on them with equanimity. Besides there is another arduous duty to be performed! Because of their underwater surroundings, the eggs must be aërated to supply sufficient oxygen, and Father Stickleback is obliged to turn himself into an animated electrical fan. For ten days and nights he vigor-

ously fans the precious eggs with his fins, leaving only when obliged to drive away intruders, and forced to depend for a living on what food chance sends his way. But notwithstanding that he might well have tired of the job, when the babies presently appear, he mounts guard with solicitous care. Every now and then he pokes his head in the window to make sure that all is right. As the youngsters come on, they get frisky and adventurous, as young things will, you know. But, if any of them ventures outside, they get sent back in a hurry. Father Stickleback knows only too well how many hungry mouths there are in waiting, and he does not intend that any of them shall be filled at the expense of his children. So the little Sticklebacks must content themselves as best they may until they have grown strong and brave like their sire.

"There are some dozen or so types of sticklebacks. The sea stickleback is the largest of the clan, often measuring a trifle over six inches. The nest of this species is not built on the sea-floor; that would usually be at a depth too great even for the courageous sticklebacks. Instead, it is always firmly attached to seaweed alongside some overhanging rock or bank. One species, the nine-spined stickleback, builds a nest much like the oriole's pocket."

"We have in the bird world one family of ce-

ment workers whose nest is glued together stickleback style," said Auntie in her turn. "It is that of the chimney-swift, or chimney-swallow, as it is often wrongly called. The chimney-swift is no kin at all of the swallow family which delights in stringing their adobe homes along under our eaves. It is a cousin of the nighthawk and the whippoorwill, and its name chimney-swift illustrates one of the few instances of real aptness in bird christening. The nests are commonly constructed in unused chimneys; hence the first part of the name. And *swift* is added in token of the birds' wonderful powers of flight and endurance. They have often been known to travel a thousand miles in a single night and day. Their flight is a peculiar rowing motion, not graceful, but very sure and powerful. The birds are sooty gray and about an inch shorter than the English sparrow, but their long wings extending way beyond their funny spiked tail make them seem much larger. Their feet are strong and muscular with very sharp claws, and as they cling to the sides of the chimney they prop themselves woodpecker-wise by their tails, suggesting that they might have been thrown like a pin-dart and stuck.

"Nearly the whole day is spent searching the air for flying insects. If no chimneys are to be had, the swifts will content themselves in a hollow

tree, or in belfries and cupolas. Here the night is spent, the very air often being black with the colony returning at eveningtide; and here the nests are made in lattice effect with twigs broken off by the birds while in flight, and fastened together and to the support with a sticky substance from the builder's mouth. Five or six pure white eggs are laid for a sitting, and usually two broods are hatched in a season. So you see that similarity in craftsmanship is the only thing that swifts and sticklebacks have in common, unless we except their remarkable courage and endurance and the business-like way in which their children are reared. It is said that the parent swifts cautiously crowd their little ones from the nest to teach them to cling to the walls and learn the proper use of claws, wings, and tail."

SOME HOUSE-BOAT BUILDERS

"Miss King gave us *The Chambered Nautilus* to learn to-day," said Alice. "At first it seemed awfully hard, but after she had told us about this little creature of the ocean, I got at it better."

"Is it not queer how the nautilus grows by building a 'more stately mansion' all the time?" queried Tommy. "Just imagine walling up one's old den with a curved plate of pearl and moving into newer and larger quarters! They say that empty nautilus shells of many chambers are often cast up by the sea. That is how the little animal comes by the name 'the chambered nautilus.' In some places it is known as the pearly nautilus."

"And a beautiful shell it has," said Auntie. "But not more beautiful than that of the paper nautilus, which has a lovely white-fluted shell, so thin and transparent that it shows the dainty rose and silver tints of the body beneath."

"One of the strangest things about the nautilus," observed Alice, "is that it is not fastened to its shell. Neither does it quite fill it. Its shell is just a dainty little house-boat in which it floats

through its watery domains. But instead of going forward it goes backward! Sometimes it crawls on the floor of the sea head downward with its shell on its back."

"The real use of the shell, however," said Auntie, "is to serve as a cradle for the little ones, for it is only the mother nautilus that is provided with a shell. In this lovely floating cradle the babies are safe from the many dangers of the ocean."

"We have an interesting little house-boat builder much nearer and better known than the nautilus," Uncle John now remarked. "She has been receiving considerable attention the last few years. I wonder if you can *guess* her. When she wishes to travel about over the sands, she carries her boat on her back. Although not a swift traveler, she often goes a considerable distance. I saw her footprints down by the boat-house this very afternoon. She ——"

"Ah, it's a *snail,* Uncle John," exclaimed Ruth, disappointedly. "I ——"

"It isn't either, Miss; don't interrupt," Tommy cried scornfully, himself unmindful, in spite of all Grandmother's warnings, that "Example is better than precept." "Who ever pays any *attention* to a snail!"

"Has but one foot," Uncle John continued serenely, wisely ignoring these "asides." "And

this is such a queer shape perhaps *you* wouldn't even think of calling it a foot. It is merely a soft cone-like mass of flesh, sticking out between the two walls of the house. And in order to stand upright the creature is obliged to sink the broad end of its dwelling deep into the sand. This it is that leaves the curious, weaving deep-pocked line which marks her trail.

"If you observe this little creature's house closely, you will find that it has an ideal system of drainage. In the end opposite the foot are two peculiar openings; water comes in at one and goes out at the other. This avenue also provides for ventilation, supplying all the air the little animal needs. The outlet is fitted with a very fine sieve, which carefully strains out the food the creature requires. And a very dainty appetite she has! For the food she loves consists of such small organisms that human folks can see them only with the aid of a magnifying glass.

"A startling fact about this creature is that she has no head. She can hear a little and smell a little by means of nerves. But sight and smell as we know them are altogether unknown to her. There are teeth, but they are not located in the mouth, and she uses them for a business altogether foreign to the usual purpose of teeth. She locks her door with them! And a very dependable lock they make. If you succeed in breaking

into her house, you will see these teeth in uneven projections on either side of the door hinge, and so arranged that the teeth on one side fit into those on the other.

"This wise mother keeps her tiny triangular-shaped babies close in the house-boat with her through the summer months. And as they grow things become rather messy and crowded, for often there are as many as a thousand of these babies at a time! In early winter the mother sends them off to see the world, and as they rush out the door they are in such haste to be gone that the water near them looks quite milky.

"All about are a host of hungry neighbors—tadpoles, frogs, water bugs of all kinds, fishes, dragon-fly children, and perhaps ducks or geese and some one of the snipe family or others of the water birds, which wade about looking for just such food as this small creature's children. So there are perils of all sorts to be avoided, and the babies are well-nigh helpless among them. Some are snapped up at once, others are trodden deep into the mud and smothered, still others swim haphazardly about and presently die of neglect and go to the bottom, there to feed the countless creatures which are nosing about. But a good many manage to settle on or near the fins of a passing fish, and snuggle down in content. For the fish is a kind host, but perhaps not an

altogether unselfish one. He knows these tiny morsels will be delicious eating by and by. So he throws a thin, colorless covering over them, which protects them like a capsule. And there they spend the winter, using him as a sort of house-boat, and growing in their odd transparent nest as thriftily as the baby moth does in its silken cocoon.

"When the tiny creatures have come to look just like their mother in everything but size, they leave their good friend and set out to take their chances in the water world again. This time they are more able to fend for themselves. Indeed, they are so far grown up that they begin at once to look about for a location to settle down in, where they can begin to fashion a house-boat of their own. Moreover, the muddier the site the better! The sea-going cousins of the species have long siphons which they can shorten or lengthen at will. They are fond of burrowing deep in wet sand, with only just their siphon mouths sticking out to glean food from the tides as they wash above them.

"As our friend works, she is fond of leaving her doors wide open. And, as you may imagine, sometimes strange things come wandering in,—a frog's foot, a bird's toe, or perchance the toe of a boy. Then snap goes the door, and you may guess what happens! Often a few grains of sand

lodge in the creature's body, and then a miracle begins ——"

"Oh, I know, Uncle John," Ruth again interrupted excitedly. "It's an oyster! Not the miracle,—that's a pearl. But it's an oyster you are describing."

"No, it isn't," assured Uncle John, stoutly.

"Of course not," affirmed Tommy. "No one ever saw an oyster down by our boat-house! And Uncle John said he saw this creature's trail there this morning! Subside, chicken."

Ruth obligingly clapped her hands over her mouth, but it was plain from her dancing eyes that she had another guess coming.

"As soon as the little creature feels the irritation of the sand," continued Uncle John, "she throws over it a thin, milky substance called nacre. Thus penned in, the sand and the nacre together at length turn into a beautiful pearl. And it is to get the pearls that thousands of these little creatures' homes are taken from our rivers, lakes, and ponds each year. Indeed, along the Mississippi River more than one thousand people are at this work all the summer long. . . . Now, what is it?"

"A *clam!*" shouted Ruth.

"Yes, a clam," agreed Uncle John, "or more properly speaking a mussel. Clams are really creatures of the sea. They differ con-

siderably in structure and habits from the mussel."

"I was reading about them yesterday," said Tommy. "And they surely are an interesting set! Why, just think of it! Giant clams of Japan have valves nearly two yards long and weigh over five hundred pounds. The Indians made their famous wampum from the beautiful purple shell of our best-known clam, the quahog, the young of which appear on elegant menus as 'Little Necks.' And then there's the beautiful 'bear's paw' of the Indian Ocean, all mottled with gorgeous splotches of red and yellow. . . . Oh, I could tell you yards about clams!"

"Save them for the story hour," advised Alice. "I want to know more about the fresh water mussels. How long has fishing for pearls of this type been going on?"

"I believe the first great mussel pearl was found in the State of New Jersey in 1857," informed Uncle John. "It was called the 'Queen Pearl' and was sold to the Empress Eugenia for $2,500. It is now worth about four times that sum. The mussels of the Mississippi River and its tributaries have yielded so many pearls that a fine trade in the pearls of fresh-water mussels has sprung up. I think you can find considerable about this in the encyclopedia. Your father once

spent a vacation pearl gathering near Macgregor, Iowa. It was quite a fad in those days. Get him to tell you all the ins and outs of the business.

"Large mussels will not live in an aquarium, Tommy, but if you could get hold of a few babies this winter, you might get a lot of amusement studying their habits. But you must be careful not to put them where the crayfish and water beetles can get at them. In the water as on the land the supreme rule of the little people is always 'He lives longest who is strongest.'"

OTHER FAMOUS BUILDERS

"SEE the coral necklace Grandmother sent for my dolly!" cried Ruth, joining the others on the wide porch where a rain had kept them all the long afternoon. "Don't you think it is just too cute?"

"It certainly has a beautiful color and polish," smiled Alice. "Imagine going coral fishing! Red coral comes from the Mediterranean, doesn't it, Auntie?"

"The best of it does, I believe," replied Miss Merryhew. "There are coral farms off the Algerian coast that are divided into ten parts, and one part is fished each year. Thus you see it takes ten years to grow a coral harvest. The value of the coral depends upon its size and color, rose-pink being the most valuable. This sometimes brings several hundred dollars an ounce, while ordinary red pieces are worth only about ten dollars an ounce. This doll's necklace was made from small bits, which sell at only a few cents an ounce. Black coral probably brings the highest price of all, but it is very rare.

"Coral has been used for jewelry since the earliest times. The ancient Gauls used red coral

to ornament their weapons and helmets. The Romans made coral necklaces for their children in the belief that the coral preserved them from danger, and even in Italy to-day coral is worn to keep off the evil-eye."

"What *is* coral, anyway, Auntie?" asked Ruth.

"It is the skeletons of some of the most beautiful and interesting animals of the sea. Their home is in the deep water of the warm ocean, and they are such delicate creatures that it is impossible to take them from their home alive. In the living coral the skeleton is covered with soft flesh and all over the surface are tiny starlike animals called polyps. Each one of these polyps live in a tiny cup or hollow in the skeleton, and even one small branch may hold as many as a million of these tiny homes. It takes countless numbers of polyps to make up a coral family.

"Inside the little cups are partitions that do not quite reach the center. The stomach of the animal hangs down between these walls. In the center is the mouth, and the polyp captures its food by means of tentacles and lasso cells. Baby polyps are not fastened in one place. They sail the ocean until their stomach and tentacles are formed, and then a building site is chosen and they settle down to build their skeletons. First of all, lime is secreted from the sea-water and de-

posited in the soft flesh until the little cup-like room with its partitions is formed. After a time buds or tiny branch-rooms start out from the sides and a coral family is begun. This goes on budding and branching until it has become a great coral community. As it grows, the lower portion dies, and thus the living polyps are found only at the top and ends of the branches.

"There are many species of coral, but only the red, pink and black coral grows in branches and is capable of taking on polish. Hence these are the only kinds of market value. White coral also grows in branched form but is not valuable. Coral is found growing in solid masses, in the form of beautiful vases, and in odd, tube-like clusters. All are gayly ornamented with star-like polyps in a variety of colors. Usually the warmer the ocean, the more delicate and wonderful the colors.

"The organ-pipe coral is one of the most interesting forms. It grows in red or purplish tubes connected by flat plates. The polyps are dressed in beautiful shades varying from violet to grass-green, and make a wonderfully gay appearance on their ruddy tubes. These corals are found in the Indian and Pacific oceans. The mushroom coral looks for all the world like an everyday mushroom turned upside down. It is the home of a single large polyp.

"To my mind, the most wonderful thing about these tiny animals of the sea is their power to build islands and great reefs of coral. Perhaps you may have heard of the Great Barrier Reef of Australia, which is over one thousand miles long, or of our own Florida Keys? Considering that coral polyps build at the rate of about three inches in height per year, think how many years of labor must have gone into these! Indeed, it is said that the Florida Keys were from one thousand to twelve hundred years in building.

"Many kinds of coral polyps take part in the building of a reef, some being able to work in one depth and some in another. All of them must have clean, fresh sea-water, which is never cooler than sixty-eight degrees."

"They certainly are wonderful little animals," said Ruth, when her aunt had ended; "and I shall like coral all the more after this."

A BAND OF TIRELESS HUNTERS

"SHH!" The warning was sharp and full of portent.

Alice, coming singing up the garden path, stopped instantly and turned to spy the heads of Tommy and Max thrust around a screening hedge of lilacs. One of Max's pudgy fingers beckoned insistently, and she went smilingly to obey the summons, tiptoeing softly.

"There's a tiger, a vicious little black and red tiger, right over there in that clump of snapdragon," the lad whispered intently, as she stooped beside him. "Tommy and I have been watching it for half an hour, and you never saw such a bloodthirsty little creature. It has killed a spider, a granddaddy, three or four ants, some flies, and a stink bug, and still it longs for more. Regular little old pirate! Ha, see him; he is after another spider!"

Quick as a flash a little bug, not more than three-quarters of an inch in length and curiously marked with red and black, dashed out from cover, and one could well fancy the frightened, dismayed gasp of its prey. The struggle was

brief, for the spider, taken all unawares, received a cruel poisonous thrust in a vital part and succumbed with scarcely an attempt at defense. The bug, without a pause or a backward glance, promptly returned to hiding and composed itself for another spring.

"The heartless little wretch!" Alice ejaculated. "It never took even one single bite. It kills for the very love of killing. I never heard of such an unprincipled little assassin."

"Ha!" cried Tommy, slapping his leg delightedly. "You've *named* it. I remember now of reading about the assassin bug just the other day. The writer said that the little butcher often killed his prey without even so much as tasting it, or perhaps sucked just a little of the choicest parts and left the remainder for the carrion eaters. About the time of Jack Frost's arrival in the autumn they cluster together in companies, just as the little red and black dotted ladybirds do, and seek out some shelter where they may sleep over the winter. A stone or bit of bark will do, but they prefer to get into cracks and crevices in the house.

"The assassin bugs are our friends. We can feel sure of that by the number of insects they kill. True, the little tiger we have been watching has laid out a host of our friends this time. It ——"

"You wouldn't term the stink bug a friend, would you?" Max interrupted quickly.

"Well," said Tommy slowly, "we seldom acknowledge it as one, and yet when it prowls around over our berries, it is after insects that eat the fruit. Ordinarily, too, as I was going on to say, the assassin bug eats aphids, harmful caterpillars and such like. But he never stops for class or size when his blood is up; they say he will tackle any animal and have his toll in blood, if no more. One species has a liking for human blood, and following the general tactics of the clan it prefers to steal in and take its victim off guard. Somehow it has learned that folks get into beds to sleep; so it does not hesitate to hide under the covers and wait for the sleepers. In some places they are real pests, and have earned the name of giant bedbugs. Science terms them the blood-sucking cone-nose. It is said that these creatures are nearly always to be found in the nests of field-mice.

"Another member of the clan has a special appetite for the true bedbugs. It is said that a colony of them turned loose in an infested house will clean out the bedbugs root and branch. Bedbug killer it is called. But it also feeds eagerly on flies and cockroaches. The young of this tribe is an adept at camouflaging. It creeps about in dusty places and painstakingly covers its brown

coat liberally with fuzz and lint. It is not so easily noticed that way and thus escapes being used for food by the hungry creatures which may pass by. When it gains strength enough to defy its enemies, it boldly casts off its dusty armor and goes out for blood."

"If you will remind me in the morning," said Uncle John, after listening to the tale of the tiger at the supper table, "I will show you a cluster of assassin babies. I saw a whole family of them yesterday, grouped at the base of a red maple twig. They are about as big as a pin-head, and so nearly the color of the young leaves that I all but passed them by. I suspect they are getting their living from the aphids which are usually pretty plenty about the young leaves. As they grow older, the young assassins will lose a large portion of their red color. It is just a kindly provision of Mother Nature for protection in their helpless stage.

"Assassin bugs are powerful in flight, and travel about as suits their pleasure. Their lairs are everywhere in the trees and in the grass, and their methods are so stealthy that though their prey is often much larger than themselves there is little chance of escape. Their weapon is their terrible beak which pierces through and through. Useful as are the little assassins to man, it behooves us to give them a wide berth. Nearly all

of them have a beakful of poison, and their bite causes a painful swelling, and sometimes serious illness. Some ten or twelve years ago the papers made a good deal of a kissing-bug scare that spread over the country like wild-fire. It was occasioned by one of these human-blood lovers having bitten a young woman on the lip; even Aunt Ruth here was afraid to go outside for many weeks. Two species of the clan have been termed kissing bugs. They are found from the Central Mississippi valley to the tropics, and are thought to breed in the nests of mice just as their kin the giant bedbugs do. They fly mostly at dusk and in the early eveningtide.

"One of the commonest assassin bugs in the South is that known as the wheel bug. The negroes term it the devil's riding horse. I haven't seen one for some time. Perhaps because I haven't been specially watching. We used to see their odd-looking eggs attached to the bark of trees and on old rail fences in the late fall and winter. They are like tiny leather milk bottles, grouped in hexagonal clusters, some seventy or more in the lot. Each bottle is capped with a tight-fitting lid which the young bug pushes off when it is ready to come out in late spring. It is a queer-looking creature, with a blood-red abdomen and thorax sprinkled with black. As it walks it curves up its abdomen in a funny hitch-

ing style. Its food at first is plant lice and other soft-bodied creatures, but as it grows larger and stronger it attacks larger insects, and when full grown is a great slaughterer of the caterpillars which feed on the foliage of trees. The bugs are not truly grown up until after the fourth moult, at which time they lose their red protective colors and appear in dull black, developing also a peculiar crest on their thorax by which scientists know them as the crested assassins. The shape of this crest is a half-circular cog-wheel with nine teeth; hence the popular name of wheel bug.

"There are more than one hundred and fifty kinds of assassin bugs in the United States. All are about the same size and shape, though variously colored. Their murderous beak fitted for piercing and sucking characterizes them. All of the tribe exists over the winter in queer-shaped eggs, and the young are shielded by protective coloring and various dust and web camouflages. A certain species called the thread-legged bug, or Emesa longpipes, is one of the oddest specimens imaginable. It has enormously long thin legs, and as it creeps along in search of prey it seems to thrust its narrow pipe-like body up and down. The longpipes is an artful brigand which haunts the vicinity of spiders' webs, maliciously cutting down the 'meat' which the weavers hang for their own use.

"The assassin bugs are about the only friends of man in the great and numerous clan to which they belong—the *Hemiptera,* numbering around twenty thousand species. Their kindred are lice, scales, tree hoppers—which, by the way, are the real brownies in their odd horned, peaked, or three-cornered caps—the aphids, chinch bugs, and like pests which prey upon plants and men, biting their tissues and sucking their life blood. Root and branch they are such an injurious, obnoxious race that Sharp, in writing of them, says: 'If anything were to exterminate the enemies of the *Hemiptera,* we ourselves should probably be starved in the course of a few months.' And it is only too true; for rapidly as these pests multiply and as tireless as they are in the hunt, they would soon possess the face of the earth."

"Apropos," said Father, "I was reading the other day that entomologists have discovered a way to wipe out chinch bugs with chinch bugs. It seems that there is a plague which when once loosed among them kills them by the million. So, when the government officials get word that the chinch bugs are on a rampage in any particular territory, they ship in sick bugs by the box full. Shortly the disease spreads among the marauders and the foe is vanquished."

"One of our best natural enemies of the chinch bug is the quail, isn't it?" asked Tommy. "And

that reminds me, did I tell you of the little family I saw yesterday? I was coming home from Daddy Thornton's up across the cornfield, going sly, with an eye open for whatever I might meet, when I stumbled upon the prettiest sight I've ever seen—a mother quail and some twenty-five or thirty of the heartiest, fluffiest, bright-eyed little babies. Mrs. Bob never even had a hint of me, and she was rustling grub for dear life. She would give an odd little cry which I soon learned meant: 'Watch, now; keep your eyes open.' Then she would jump up against a stalk, and beat it sharply with her wings. Instantly a shower of bugs would fall, and such a scramble as there was then among the babies! I watched the busy little crew for a half hour or more, and you don't know how glad I was, Father, that you have always insisted that no one should hunt quail on our farm."

SOME NOTED BEACON BEARERS

"TOMMY!" exclaimed Mother, aghast, "how in the world did you get that great gash in your foot, child?"

"Why-ee," the lad returned, startled, "I—I didn't!" and he lifted his bare foot for examination.

Instantly there was a shout of laughter from those assembled on the moonlit porch; for what seemed to be a gaping wound was the shining beacon of a firefly or lightning bug which the boy had accidentally ground into his heel.

"Well," ejaculated Tommy, regarding the "wreckage" in rueful surprise, "I thought every firefly that had wings was in the air to-night!"

"So they are, boy," returned Uncle John, quickly; "the poor creature which met its fate at your hands—or I should say *heels*—had not yet shaken out its wings. It was probably fresh from its cocoon in the earth. Or perchance it was not a firefly at all, but its close kin, the glowworm. Indeed, from the extent of its luminosity, I should judge the latter to be the case. As the time draws near for the glowworm weddings, the male glowworms develop wings and take to

the air. The females, poor things, never know the joy of flight. They are doomed to keep their larval shape for aye, but they will not be deprived of lovers. So they proceed at once to kindle a blazing beacon which shines with a glorious white light, tinged with blue, plainly advertising their presence from afar. We often see them glowing in the grass like bits of starshine, and twinkling almost as rapidly as the stars themselves.

" Catch one of the little coquettes, and we are surprised to find that the beacons are kindled on the lower surface of the abdomen, and hence must face the ground. How then is it that we catch their little gleam? But wait! Put the little glower back in the grass; like all females since the days of Eden she has her wiles. Watch her twist about. First she jerks her flexible abdomen this way, then that. The beacon's light flashes like a signaling mirror. It cannot help, sooner or later, attracting the eye of every swain in the neighborhood, for these fellows are provided with an optical apparatus which rivals the famous eye of Cyclops. It is a double-lensed affair filling almost the whole face and protected by a peaked cap or shade which aids him to focus his vision on a limited area at a time. Indeed, so thorough and intent is his gaze that probably the tiniest luminous streak would be sufficient to guide him.

"The round white eggs when laid are strewn at random on the ground or on a blade of grass. Mrs. Glowworm takes no interest in them, for in her bosom is no spark of family ties or affection. The eggs shine like tiny specks of quicksilver, and in a very short time the young are out, each with their two little rushlights on their tail. Their prey is earthworms and snails, and they have the most voracious appetites. At the approach of Jack Frost they burrow in the ground and remain hidden until the warm days of late spring lure them forth.

"The glowworm is not actually a worm, by the bye, but belongs to the beetle family. None but a Fabre or Savarin would ever think of saying to the glowworm: 'Show me what you eat and I will tell you what you are.' But the old naturalist, knowing that 'The data supplied by food are the chief of all the documents of life,' canvassed the case thoroughly and set down the facts. 'In spite of his innocent appearance,' he tells us, 'the *Lampyris* (or lantern-bearer) is an eater of flesh, a hunter of game; and he follows his calling with rare villainy.' But mercifully, too, as we see, for the glowworm administers an anæsthetic: he chloroforms his victim before setting to work to eat him. Furthermore, there is included with this strange numbing secretion, which is injected in various little jabs, a sort

of pepsin that turns the flesh into a liquid which the glowworm sucks up, feeding it may be for days and days at the same table.

"This ability to turn flesh to liquid is not the glowworms' alone. The burying beetles have it; so, too, do the bluebottles, the greenbottles, and the big gray flesh flies. You may perhaps have seen some of these little carrion lovers at their repulsive feast. You turned shudderingly away, of course, and yet the service which these scavengers render is of inestimable value. They help to return to the earth with all speed the remains of that which has lived; they give back to Mother Earth an essence which enriches her soil, and at the same time they do away with a loathsome object, which if left would pollute the air all around, spreading disease and death.

"The tools with which the glowworm performs his wonders are simple enough. They are merely two hollow little fangs, much like the spears which our friend Madam Doodlebug uses to thrust into the ants which she entraps in her clever wells. But the ant-lion, as we know, merely sucks the blood of her captive and tosses his carcass out over her head on to the rubbish heap. The glowworm, using the same tools, is more efficient; by reason of the addition of its liquefying pepsin it is enabled to make a clean sweep. No plate washed in our kitchen was ever

cleaner to all outward appearance than a small shell drained by the *Lampyris*.

"Feeding upon such a questionable diet, one would expect the glowworm itself to be a rather messy-looking individual. Nothing is farther from the truth. For the little creature has on its hind quarters a combined wash-rag and clothes-brush, which it uses with scrupulous care after each contact with its evil-smelling mollusc tubs and what not. And so flexible is its body that not a part of its anatomy is missed in the scrubbing and dusting. A glowworm's toilet is never by any chance 'a lick and a promise.' Indeed, I could mention various persons who do not take anything like the pains with their toilet that the little lantern-bearers do!

"Their clothes-brush also performs another valued service. It is made up of twelve little tubular fingers which are capable either of being spread out like a rosette or gathered up in a little cluster. When the *Lampyris* climbs a stalk in search of prey, it opens wide its sticky rosette and spreads it out to keep itself from slipping and falling. The rosette further serves as a sort of propeller, for by opening and closing, it aids the lantern-bearer to hitch itself along after the manner of a cripple in a wheeled chair.

"An interesting cousin of the fireflies and glowworms is the railway beetle of South America.

This strange creature flashes a red light at each end of the body, and a green light along the sides. Another South American beetle is a favorite among the natives as a hair ornament, because of its flashing yellow light. Certain luminous beetles and fireflies are imprisoned in punched gourds and cocoanut shells and used by various wild peoples in lieu of lanterns. As you may imagine, however, these ingenious lanterns give little light. The click beetles, which you boys like to turn over on their backs for the mere fun of listening to them click as they right themselves, are other members of the beacon-bearer clan. Their larvæ are the pestiferous wireworms which eat our potatoes, carrots, and beets, and do damage under the bark of trees.

"Most of the beacon-bearers are easily reared in captivity. Seems to me I never saw more of them abroad than are to be seen to-night. Their tiny lanterns are flashing everywhere. What do you say, boys, let's get a few specimens."

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THE SOUTH AMERICAN "LIGHTNING GRASSHOPPER"

AN INTERESTING LITTLE HOUSE BUILDER

Uncle John and the children had been away for an all-day tramp, and the things which they brought home would, as Mother dryly observed, have "cluttered up a museum!"

"Give us time, Lucy," her brother smiled boyishly, "and we will have them all labeled and tucked away in first-class house-keepy fashion. Such hosts of story topics and illustrations as we have, mostly along lines pertaining to our little craftsmen neighbors."

"If you are going to talk about them," put in Ruth eagerly, "tell about mine. You said you would this evening."

"All right, honey," agreed Uncle John, settling comfortably into a big easy-chair. "I suppose we might as well get that off our hands the first thing," and from his pocket he produced a shell which brought a howl of derision from the boys.

"A *snail* shell," ejaculated Max. "We all know about snails."

"It isn't either, smarty," his small sister re-

turned in tart defense. "You said it was Mrs. Helix, didn't you, Uncle John?"

"I did," her uncle confirmed briefly, "that is the name she always has engraved upon her visiting cards. Before starting her life history, however, if the court pleases, I would like to recite a bit of old-time verse," and he gave the following:

THE CATERPILLAR AND THE ANT

A pensy Ant, right trig and clean,
Came ae day whidding o'er the green,
Where, to advance her pride, she saw
A Caterpillar, moving slaw.
"Good ev'n't ye, Mistress Ant," said he;
"How's a' at hame? I'm blyth to s'ye."
The saucy Ant view'd him wi' scorn,
Nor wad civilities return;
But gecking up her head, quoth she,
"Poor animal! I pity thee;
Wha scarce can claim to be a creature,
But some experiment o' Nature,
Whase silly shape displeased her eye,
And thus unfinish'd was flung bye.
For me, I'm made wi' better grace,
Wi' active limbs and lively face;
And cleverly can move wi' ease
Frae place to place where'er I please;
Can foot a minuet or jig,
And snoov't like ony whirly-gig;
Which gars my jo aft grip my hand,
Till his heart pitty-pattys, and—
But laigh my qualities I bring,
To stand up clashing wi' a thing,

A creeping thing the like o' thee,
Not worthy o' a farewell t' ye."
The airy Ant syne turned awa,
And left him wi' a proud gaffa.
The Caterpillar was struck dumb,
And never answered her a mum:
The humble reptile fand some pain,
Thus to be banter'd wi' disdain.
But tent neist time the Ant came by,
The worm was grown a Butterfly;
Transparent were his wings and fair,
Which bare him flight'ring through the air.
Upon a flower he stapt his flight,
And thinking on his former slight,
Thus to the Ant himself addrest:
"Pray, Madam, will ye please to rest?
And notice what I now advise:
Inferiors ne'er too much despise,
For fortune may gie sic a turn,
To raise aboon ye what ye scorn:
For instance, now I spread my wing
In air, while you're a creeping thing."

—Allan Ramsay.

The boys looked at one another a bit shamefacedly as he finished. "But, nevertheless, Uncle John, the thing *is* a snail shell," defended Tommy, as a smile went the rounds.

"To be sure. Mrs. Helix is the dignified name, as I said. On everyday occasions we speak of the occupant just as Mrs. Snail. But don't imagine she is not interesting and important, Ruthie. Of all the queer little people that go plodding through the world on one foot, carrying

their house on their back, Mrs. Helix is the very queerest. Just imagine: her head is in her foot, her eyes are located in her horns, and her teeth are in her tongue!"

"Honestly?" queried Ruth, divided in what to believe.

"Cross my heart," assured Uncle John solemnly, "and that is only a beginning. Snails do their eating and traveling, too, almost entirely by night. We often find their shells, emptied by who knows what tragedy. But we are not so apt to stumble upon the snails themselves. They have hiding-places under leaves, rocks, and logs, and around the roots of trees and bushes, and they well know when to keep hidden. The garden snails thrive best in damp places and are happiest along shady walks in old gardens. There are several varieties of snails, but whether they live in garden, field, or woods, pond or sea, their general make-up is pretty much the same.

"The snail's body is a jelly-like mass, and when it pleases can be drawn securely into the shell. The entire lower part of the body is its foot; so, you see, the snail has a very good understanding. This foot is, in truth, a creeping disk, which is cleverly arranged to oil itself by means of a sort of mucous which issues from an opening in the bottom. By drawing up the foot and setting it down again sharply the snail manages to

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A SNAIL "RACE"

carry itself forward literally by stamping its foot, a method which seldom avails in the human world. It is not a swift traveler; indeed 'a snail's pace' is proverbially known as the very slowest of movement. But by keeping steadily on, the little creatures make progress eventually; some snails even manage to climb trees. Their sense of touch is most acute, and here is the strange part, the snail feels with its eyes! These eyes, as we have said, are in the horns, and when a snail draws in its horns it really shuts its eyes. It has a keen sense of smell, but it has no nose. Scientists believe that the skin somehow serves as an organ not only of smell but of taste as well. The snails breathe from a lung sac. Most pond snails are obliged to come to the top of the water every few minutes for air. A few of them, however, breathe as the sea snails do, by means of gills.

"The snail is strictly a vegetarian. In early spring its food is tender green plants; later dead and dry leaves are made to serve. Its tongue is a sort of ribbon covered with little points that accomplish the purpose of teeth. When it eats, the food is pressed against the teeth and rasped off very cleverly and neatly. The snail never needs to go to the dentist; its teeth are renewed from the membrane at the core as rapidly as they wear away.

"In the spring the garden snail's eggs are deposited about two inches below the surface of the earth. There are anywhere from thirty to one hundred of them, and in comparison to the mother they are large indeed, being about the size of small peas, soft and round and nearly transparent. In about twenty-five days the young come forth, looking very much like their mother, already having their tiny shells and ready to take up the real business of life.

"During the dry heat of summer, the land snails retire into their shells and close the door by a membrane. This odd curtain is another snail miracle. It is made by throwing a limy mucous out over the opening, much as a soap bubble is blown from a pipe. The lime soon hardens, and the snail is carefully protected from the elements. The same procedure is followed in winter, sometimes as many as five or six layers of membrane being formed if the weather is severe. Snails have as many lives as a cat. They can stand all sorts of rigors and vicissitudes. An instance is cited of a pond snail which made a long sea voyage packed up in cotton wool. When placed in water it promptly revived, came up for air, and set about taking in food.

"Let me read you a few lines I clipped the other day," and Uncle John produced his ever handy note-book:

The frugal snail, with forecast of repose,
Carries his house with him where'er he goes;
Peeps out, and if there comes a shower of rain,
Retreats to his small domicile again.
Touch but a tip of him, a horn,—'tis well,—
He curls up in his sanctuary shell.
He's his own landlord, his own tenant; stay
As long as he will, he dreads no quarter-day;
Himself he boards and lodges; both invites
And feasts himself; wheresoe'er he roam
Knock when you will, he's sure to be at home.

—Charles Lamb.

"This specimen which Ruthie found is no empty shell. The little creature is 'at home.' All we have to do is to knock to be in possession of various bits of snail information and illustrations. It is of the garden type. So if you will put it on a raised pane of glass, with some pea-vine, toadstool, or cabbage for a tempting appetizer, you will soon see the little creature poke out a foot. Shortly, if it is satisfied that all is well, it will begin to stamp itself along toward the food, and you may see it both walk and eat.

"None of our little craftsmen builds a daintier, more elegant home than the snail. The shell is always a spiral, and there are many different sizes and colors. Each turn is called a whorl; the largest one is the body whorl. The spaces between the whorls are the sutures, and the upper part is the spire. The apex is the tiny shell that

covered the young snail in the first days of its career. How carefully and wisely it builds as time goes on! The color of the shell is determined by the skin covering which protects it carefully so long as the little animal lives. This skin may be smooth, rough or hairy. The particular family to which the snail belongs is distinguished by its color, size, and the number of whorls. For example, there are two kinds of pond snails, known as 'right-handed,' and 'left-handed,' according to the direction which the coil turns from the apex. The left-handed species are the most numerous in our streams; their scientific name is the *Physa*. They do well in a jar of water, and I shall try to find a specimen for you. The eggs will be laid in a transparent mass of jelly on the side of the glass, and we shall have the pleasure of watching the young come forth. The beating of the heart is easily seen some hours before the egg hatches. I have often noted pond snail eggs sticking to boards and stones in quiet waters. Indeed, I would not be greatly surprised if there were some clinging to the bottom of our boat right now.

"Snails are found all over the world. In European countries, especially in France and Italy, several kinds of snails are used for food. They are frequently to be seen pictured on the signboards of restaurants. Often the food which

snails eat in their wild state makes them poisonous to man; hence it is the custom to have snail gardens, where the snails are fed and fattened for table use.

"Slugs are close kin of the snails. Their 'house' is the merest apology, being simply a plate-like shell buried in the mantle on the back. The commonest kind is the small, dark-brown specimen seen hiding under boards and logs by day. Like the snails, slugs are nocturnal in their habits. Across the water they do no little damage to gardens, but in America, aside from the occasional ravages of pear, currant, and rose slugs, we are little troubled. Slugs are always vegetable eaters. They often ascend trees and bushes in search of food. When they are ready to go down, they spin out a little mucous rope by which to lower themselves. Slug eggs are about the size of buckshot, and are yellowish and semi-transparent. They are found in numbers of thirty or more massed together in the damp earth under a board."

A MASTERLY BRIGAND

"I CAME in past the new well in Daddy Thornton's pasture to-day," observed Uncle John, "and what do you think? A band of brigands have domiciled themselves in the big mound of clay. Each one has built a watch-tower of grass and dirt fastened together with silk or of twigs put in place in the same clever fashion. I caught the gleam of several wicked-looking eyes peering out at me, but when I ventured nearer and peeped into the turrets, the robbers had all fled into their strongholds below."

"Hmm!" said Tommy, shrewdly. "Weren't you afraid of being stung? They are sand wasps, I suppose?"

"No, sir. Sand wasps do not build watch-towers. They are wolf spiders, of the species particularly known as *Lycosa carolinensis,* a very close kin of the famous tarantulas of Southern Europe, whose bite was long supposed to cause a peculiar disease called dancing madness. They are large hairy creatures, dressed in black velvet underneath, with brown stripes on the abdomen, and gray and white rings around the legs.

Whether they are really as wicked as rumor credits them is to be doubted. But at all events they are to be feared, for their poison fangs are their chief and indeed only weapon in killing their prey. They have no silken cord to bind their victims, as the garden spiders have. Theirs is a much riskier job. They must leap courageously upon the foe, and strike with all the venom they possess. Moreover, they must be keen enough to choose a vital spot, for, strong as their poison is, it is doubtful if the victim could be killed instantly, unless a nerve center were struck. Fabre found that a bite inflicted upon the leg of a fledgeling sparrow and, in another instance, upon the nose of a mole, resulted in the death of both of the innocent victims within a few days. To be sure, a poison that would kill a sparrow or a mole might not cause death to a human being, but it is always wise to play safe."

"I won't touch one of them," interposed Tommy solemnly, apparently realizing that much of this preamble was for his benefit. "I promise you that faithfully, Uncle John. But I suppose a fellow may investigate them?"

"With discretion, yes; and you will find them wonderfully interesting, too. First: there's the ingenuity of their clever little turrets. These are seldom more than an inch high, but they are quite tall enough to conceal the little brigand lurking

inside, with only its head above the ramparts, its diamond-bright eyes watching steadily, its legs all gathered for a spring. And the little hunter is a monument of patience; often it must hold this ready attitude for hours and hours at a stretch. For it must wait the accommodation of chance; there is nothing about the turret to tempt a visitor, unless, perchance, it may offer an inviting ledge on which to rest for a few moments. Sooner or later, however, a dragon-fly, a grasshopper, or some other delectable tidbit passes that way; then, presto! the watcher darts from the tower with amazing swiftness, and ere the unsuspecting one can think either of flight or defense, a quick thrust in the neck ends its career.

"No full-grown *Lycosa* ever springs for a victim that is beyond its reach. It scorns to chase its prey, and it always avoids an unseemly squabble. Well enough it knows that unless it can kill at the first thrust, it is quite likely to be worsted in the fray. In youth, however, affairs are different. Before reaching a marriageable age, the spiderlings roam about like the miniature wolves that they are. When any suitable game appears they are after it hot-foot. And foiled indeed is the wary fly or midge that attempts to escape by flight. For before it can so much as rise, the acrobatic young spiderling leaps into the air and catches it quicker than a wink. Indeed, no cat

was ever quicker at catching a mouse than the spiderling is in pursuit of its prey.

"The carpenter-bee and a species of wasp known as the tarantula-killer are the *Lycosidæ's* worst enemies. The latter is a large black wasp with reddish-brown wings. It paralyzes the spider, instead of killing it outright, then calmly lays an egg upon it, and buries the living relic in a hole five inches deep. When the egg hatches, the baby wasp feeds upon its ingenious 'cradle,' till it is fully grown and ready to dig its way out.

"The *Lycosa's* stomach is as accommodating as that of a camel. It can gorge itself one day and go without another meal for an indefinite period. Fabre says that he often neglected to feed the *Lycosas* in his laboratory for weeks at a time, and could never tell that they were the worse for it. When food was finally offered them, however, they fully came up to the old maxim, 'ravenous as a wolf.'

"The retreat or stronghold of the *Lycosa* is not built until it marries and sets up housekeeping. By and by there will be a host of babies to care for, and Madam Lycosa will find plenty to do without indulging in foot races and gymnastics for her livelihood. So a well or burrow is sunk into the earth, anywhere from six inches to a foot in depth, and sometimes nearly an inch in diameter. This is usually lined with a thin film

of silk, especially if the burrow is drilled in loose soil. Near the surface it is thicker and heavier than it is deeper down; we can well understand why this should be so.

"Not one of our insect neighbors is more devoted to her family than is the *Lycosa*. If you keep an eye on the colony I have discovered, you may possibly see a female weaving her egg-sac, but I doubt it, as they are very shy. Even the less important business of turret-building is carried on after nightfall and in the dim morning hours before the early worm catchers get abroad. Fabre had the good luck to observe a weaver which he had confined in his laboratory. Early one morning he crept up and found her busily engaged in spinning a silken network on the ground. It was coarse and shapeless, but firmly fixed, and when finished covered a space about as large as the palm of his hand. This, it appeared, was intended for the floor of the spider's abode, but later the old naturalist discovered that it was only a carpet spread upon the particular spot the *Lycosa* had selected for a workshop.

"The real business in hand was the fashioning of her egg-sac, and the carpet was only a provisionary measure to keep the precious pill from becoming soiled. She began by weaving a fine little mat of superb white silk, about the size of a fifty-cent piece, with the outer edge thickened

and built up until the mat really became a sort of bowl, with a wide, flat edge. Inside this bowl her eggs were laid, and then carefully covered with a silken blanket. Would she leave them there in the bowl set in the midst of the circular carpet? Knowing *Lycosas,* the watcher felt sure that she would not, and so remained motionless awaiting events. Presently the spider began taking up and breaking one after another the threads which held the mat to the carpet. At the same time, too, she gripped and tore with her fangs, and finally by dint of exceedingly hard labor managed to tear the bowl loose and wrap it in a loose sheet torn from the upper surface of the carpet. She had now a white silk pill, soft and sticky to the touch, and about the size of an average cherry.

"Altogether several hours had gone into this accomplishment, and Madam Lycosa seemed quite tired out, but she was happy, and grasping the precious pill in her arms, she dropped off to sleep. Next morning she was found carrying the bag of eggs slung behind her, as is the fashion of all the *Lycosas.* You will be able to see this much anyway. For sleeping or waking, the mothers never let their precious egg-sacs out of their grasp, though, as you may well imagine, such burdens are often exceedingly inconvenient to drag along up-stairs, down-stairs, and in the

sudden leaps for prey. If you rob them forcibly with the pincers, they are frantic. They are easily fooled, too; if you take their sac and offer them another they do not know the difference. They will even snatch a cork or flour pill in their flurry, attach it hurriedly to their spinnerets, and make for safety.

"Another thing you will be very likely to note within a few days; this is a mother *Lycosa* sunning her eggs. You will find her literally standing on her head in her pit, with her hind legs thrust out over the ramparts bearing her white pill upward to the life-giving rays of the sun. Motionless hour after hour she remains, save for the movement necessary to shift the egg-sac occasionally so that all parts of it may be equally heated. Nor is this just a one-day performance; through the sunny hours of every day for a period of three or four weeks the little creature will be found patiently at her post. Tiresome and tedious enough the effort must be, but if the little *Lycosa* ever envies the birds sitting comfortably in their nests to hatch their offspring, no one ever knows it.

"If you look closely at the white pill, you will note a little raised fold running about its middle. This is the edge of the circular mat drawn up around the bowl to keep the eggs from spilling. When the little spiderlings are ready to come out

this fold gives way. Some think that the mother herself breaks open the wrapper at just the right moment, but it is possible that it bursts, as you will remember the banded spider's wallet does when the contents become too stout and active to be confined longer.

"As they come from the sac, the little *Lycosas,* numbering a couple of hundred or so, climb to their patient mother's back and settle themselves so tightly together that the unobservant person might pass them by as a sort of shaggy bark or scale covering. An odd overcoat they are forsooth, and one which the weary mother may not lay aside even for one moment through all the fall and winter and until the warm days of spring are at hand. Like young opossums, the spiderlings insist on being carried everywhere, but instead of a free ride of five or six weeks' duration, theirs is a matter of months. If by chance some dozen or so of them get spilled off, they are not lost. They scamper about till they find one of their mother's legs and climb up this staunch pillar to their pleasant haven.

" Strangely enough, so far as any one knows, the little spiderlings do not eat a bite while they live thus huddled together. Neither do they grow any larger. At the age of seven months, when it has become warm enough for them to be trusted abroad alone, they are no larger than

when they were born. What has kept them alive all this time? Baby chicks, you know, swallow the yolk of the egg just before coming out of the shell. This is all the food they require for forty-eight hours. Can it be that there is some such provision made for the months the little spiderlings go unfed? Fabre thinks this unlikely. The time is too long. To be sure, the mother herself does not eat a great deal during this period, and she stays plump and in good condition. Indeed, she even puts on fat. But we know the accommodating stomach she has; a good gorging meal now and then and she can exist in perfect content. And this she has, for at irregular intervals she comes up into her watch-tower, bearing her swarming, toppling burden, and waits patiently for the ill-fated passer-by. When her prey is overcome, however, the youngsters show no manner of interest in it; nor does she make any effort to persuade them to join her at the feast. To all appearances they are not hungry, and she knows it. What keeps them alive?

"It would not take much just to exist, but the spiderlings do more than this. Watch them for a time, and you will see that they are far from being in a state of rest. Each one has to brace its little self and cling to its mother's back and to its brothers and sisters to keep from falling off. When a tumble does come, they are up in an in-

stant, scurrying nimbly around until they find means to regain their position. Tiny as they are, they are evidently brimming over with energy. Where do they get it? Fabre pondered this question well, and at last he became convinced that the little spiderlings *live upon sunshine.* At first thought, this seems a very surprising thing. But, says the old naturalist, 'Why not live on sun, seeing that, after all, we find nothing but sun in the fruits which we eat?' Certainly we know that the sun is the giver of all energy, and we have seen too many miracles in the insect world to scoff at the suggestion that by some All-wise Power the spiderlings may have been provisioned so that they can occasionally lunch liberally from sunshine."

"I see no reason at all to doubt it," said Auntie slowly, as her brother looked about apparently waiting for remarks. "And the fact is suggestive: Chemists have long had a dream of supplying food products from the laboratory to take the place of those grown on the farm. Why shouldn't physical science go a step farther, and by grasping a hint from the *Lycosa* spiderlings, give us energy-producing foods direct from the prime fountain of energy?"

"I'm sure I wish it could be done," sighed Mother, who had for some time been keeping an eye on the relentless hands of the clock, creeping

nearer and nearer the time to get dinner. "Fancy dining bountifully to-night on a big dish of sunshine!"

"There's no knowing what miracle may transpire even in the near future," Grandfather contributed soberly, apparently regarding the whole project as quite feasible. "Ten years ago if any one had told me we could sit here comfortably in our own home to-night and listen to an orchestra in Chicago, I would scarcely have heeded the remark. And yet that is just exactly what we expect to do! We would no more think of doing without our radio now than we would of dispensing with our telephone, our car, or the phonograph. Shortly we may deem just as necessary some contraption for absorbing sunshine and pumping its energizing vitality into our systems: who knows? It would certainly be a tremendous jolt to old H. C. L. now, wouldn't it?"

"Hear! Hear!" Tommy remonstrated, as the group seemed separating to attend to various evening duties. "Those little *Lycosas* are not grown up yet: we can't go and leave them on their mother's back, even if they are lunching in a truly miraculous fashion. Please finish them, Uncle John."

"Very well," laughed his uncle, turning back, and pausing to lean in the doorway. "Only I shall have to be brief: About the first of April, if

the warm spring days seem to be at hand, Madam Lycosa comes up out of the burrow with her agile, squirming burden still huddled on her back. The time has arrived for the babies to leave her, but she does not seem at all concerned over the event. She seats herself calmly on the top rail of her watch-tower, and leaves the affair entirely to the invigorating influence of the warm sunshine.

" Shortly the little fellows along the outer edge begin to leave in twos and threes and by the dozen. For a little while they scamper about on the ground near at hand; then, growing bolder, they hurry away and each one climbs to the top of the tallest pinnacle to be found. Sometimes this is a weed stalk or a grassy hummock, again it may be simply a clod of dirt—anything will serve that tends to elevate the young adventurers so that a view of the world may be had. The spirit of discovery stirs in their tiny breasts; they long to get far and ever farther away. And necessity, always the mother of invention, shows them how: each little spider begins to spin, and presently casts to the breeze a thin rope of silk, so delicate and fragile that we are not able to see it at all unless it comes between our eyes and the sun. You know what happens next, for the various members of the *Lycosa* family are the little aëronauts we have seen time and again sailing along

on their silken ropes—the aeroplane of Nature's own invention. It is fashioned in the hour of need, and promptly abandoned and forgotten at the end of the journey. For the young *Lycosas* never make but one flight, and that the one which carries them far from their mother's ken. On alighting, they wander here and there hunting and feeding till summer is well on the wane. Then come a number of hasty weddings and the hurried business of getting a burrow dug and an egg-sac made and into the sunshine.

"As for Madam Lycosa, the mother of this new generation of spiders, after her fledgelings have all left her, a matter perhaps of a week or two if the weather be fair, she goes on with her hunting, pursuing her career of robber and brigand with renewed zest, until she, too, is warned by the shortness of the days to get an egg-sac hung while the great incubator is still near enough to do the hatching. If the Fates are kind, she will raise several more families one after another; for her life is a long one, as lives are counted in the insect world."

POLICEMEN OF THE GARDEN

"THOMAS LANE DAYTON," cried Grandmother, horrified, "put down that horrid toad this instant! Don't you know it will make warts all over your hands?"

"Nonsense, Mother," came Uncle John's voice in laughing protest, "that notion was exploded long ago, along with the belief that killing a toad on the premises would cause the cows to give bloody milk!"

"Why, Grandma," Tommy laughed, "times *have* changed, haven't they? To-day we look upon the toad as one of our best friends. He is the policeman of the garden, and a prime hand at catching thieves all about the place. It has been estimated that in three months the toad gets two thousand cutworms. Daddy Thornton says when he was a boy his father used to give him a penny for every cutworm he found and killed. At this rate, our friend, Mr. Toad, is worth better than six dollars per month, and he doesn't stop with cutworms. He likes caterpillars, army-worms, and thousand-leggers. And he just dotes on rose bugs! You should love him for that, surely.

Besides, there is at least one toad on record which was seen to snap up eighty-six house-flies in less than ten minutes."

"Do tell now," ejaculated Grandmother, staring in surprise. "I'm sure I never would have believed it! My mother once told me that in *her* day people thought the breath of a toad would poison a baby; she laughed at that, and it was silly, of course. But I was always taught to give toads a wide berth, and my brothers used to kill them on sight. One Saturday, I remember, they got a dozen or so at a neighbor's pond, and probably maimed several more. We thought it a splendid day's work—just so many enemies slain; and Father gave the boys a quarter apiece. Instead—why-ee—if what you say is true ——"

"Instead," finished Uncle John grimly, as Grandmother paused quite overcome with the enormity of the offense, "the little rascals should have had a sound thrashing! And yet they were not so much to blame, since no one had told them the value of the creatures they feared and despised. Toads are one of Nature's most efficient agents for combating insect pests. They are quite as valuable as birds, but whereas every one sees and loves the birds, the toads, quiet in habit and appearance, pursuing their work for the most part after nightfall, are to many people unknown, and to others objects of loathsome dis-

gust. A few, however, in all ages have sought to portray the toad as a benefactor to man. The Japanese have a proverb to the effect that good fortune comes to the house in whose new-made cellar the toad takes up its abode. Many of the early writers refer to the valuable toadstone or jewel to be found in the toad's head; others speak just as erroneously of the little creature's medicinal qualities. Small wonder, perhaps, that under all its load of false and even ludicrous misrepresentation the toad should have failed to receive its just dues! Sober, warty, and homely enough it is, in all conscience, yet judged by the standard of good works—the only real test—the toad is one of the best possible friends and helpers of the farmer and gardener."

"Toads are easily tamed," informed Tommy, as Uncle John was called to the telephone. "I mean to see what I can do toward civilizing this one. I've fixed him a nice little retreat under the stone wall in the corner of the rose garden, and I mean to teach him to hop out when I whistle for him!"

"And may I help feed him?" demanded Ruth, excitedly. "Would he care for anything right now, do you suppose?"

"I'm thinking he will always be caring," Tommy returned, shrewdly. "Try him. Why," to Alice, who had asked what was to be done with

the creature in winter, "Mother says I may put him in the cellar, if I like. But if I don't, he will know how to shift for himself. Early in the fall toads bury themselves deep in the mud, and go sound asleep. They say toads are frequently found in winter some distance below the surface apparently frozen stiff, but, strangely enough, they are not dead. They come out well and hearty and ready for the next season's campaign as soon as the insects begin to arrive. Toads have a real homing instinct. They stay in the same garden year after year. One writer mentions two toads that have lived in separate door-yards, one for twelve and the other for twenty-three years respectively."

"I was reading the other day of a live toad being found imbedded in masonry that was known to have been standing a dozen years or more," Auntie observed. "Is it possible that the little creature could have existed dormant so long?"

"Hardly," returned Father. "In porous stone or moist soil the thing might be possible for some months. But no toad, no matter how inured to hardship, could long withstand deprivation of air, food, and water. Such tales often crop up, but seldom is one to be believed. It is a matter of history that, in 1777, three toads were imbedded in plaster and placed with the archives of the French Academy of Sciences. At the end of

eighteen months two of the toads were still alive. In another oft-quoted experiment, toads were buried in cavities in sandstone and in limestone. Those buried in the sandstone lived thirteen months; those in the more porous material survived about two years. Toads are remarkably long-lived, specimens having been known to reach the advanced age of thirty-six."

"Here now, Toady," said Ruth, returning with two or three dead flies in her chubby fist. "See! Eat 'em up, quick!" and she dropped her offering before the "guest."

But, to the disappointment of all, the toad never so much as even batted an eye in thanks.

"Try him with a *live* fly, Ruthie," suggested Uncle John, again joining the group. "Here," and he deftly captured a noisy bluebottle drumming against the screen, eager to be gone. Quickly the little scavenger was tossed whirling and remonstrating in front of the toad, and presto! swift as lightning out came a curious darting tongue and the bluebottle disappeared.

"Toads seldom care for dead or motionless food," Uncle John went on to explain, after the various ejaculations had subsided, "but you see what happens when live bait appears. Cutworms seem to sense that so long as they stay curled up they are safe. But let one conclude that the toad is napping, and start to get away,

and snap! there is one cutworm less to work havoc in the garden. The toad's only weapon is its tongue, but that is quite sufficient. It is attached in front and free behind, so that it can fly out with the quickness and swiftness of a hair-spring. Moreover it is coated with a sticky substance which holds the captive until the creature's jaws close upon it. If the victim chances to be too large to be gobbled easily, the toad uses his hind legs to help crowd it down!

"Toads have an enormous capacity for food. It has been found that when food is abundant one will completely fill and empty his stomach four times in twenty-four hours. Toads usually stay hidden during the day, because they are very susceptible to the heat or the drying effect of the sun's rays upon their sensitive skin. On cloudy days and in the cool of the evening, they come out from their retreat and set busily about their business of patrolling the gardens and fields. Unless food is exceedingly plentiful, they hunt all night long, and are themselves frequently gobbled up by owls, bats, skunks, and other night-prowling creatures. In some way the toads have learned that an electric arc or other bright light attracts swarms of insects, and that these fall to the ground thereabouts in great numbers. Kirkland reports having seen eight busy toads holding a festival under an arc light at Amherst,

Mass. Such a spot seldom fails to yield up one or more toads even in the dullest part of the season.

"The toad is usually a solitary creature, save at mating time, and in the fall of the year when a dozen or more may gather in some particularly attractive place for hibernating, such as under a loose pile of boards or stones. As soon as they are out in the spring, the males set up a soft, musical calling, not unlike the chime of bells heard from a distance. '*Cling!*' says one; '*Clang!*' goes another; '*Clung!*' says a third; and so on daintily and indefinitely, '*Cling, clang, clung; cling, clang, clung!*' Which being interpreted means, '*The pond, the pond, come away!*' And they themselves lead the way to the nearest pool. The number that assembles in response to these persuasive calls is often truly remarkable. Kirkland says that he once counted three hundred and fifty-six toads on the shores of a half-acre pond.

"The egg strings of the toads are curious affairs, being composed of long ropes or strands of gelatine dotted with tiny black eggs. This gelatinous mass swells as soon as it touches the water, and is to be found coiled or matted in warm ponds and roadside pools in a mass far exceeding the body of the parent toad. The female toad swims around slowly laying her eggs, and passing

around small obstructions, with the result that the strands of eggs are festooned like a huge irregular spider web. In a short time, the eggs hatch into queer little tadpoles with a large fin-bordered tail, and a sort of temporary mouth by which they cling to weeds and water plants when at rest. For the first few days they feed upon the minute algæ[1] which coat the bottom of the pond and float on the surface; later they devour animal substances. For this reason, tadpoles are the best possible scavengers, Tommy, and you will do well to find some for your aquarium. They are easily located in shallow water near the shore, as they hide there among the water plants to screen themselves from the hungry turtles and fishes that are especially fond of tadpole dinners. You may not be able to distinguish the toad tadpoles from their kindred the frog tadpoles. But that won't matter in the least; you will have the added pleasure of watching the development of both.

" At a certain stage, the toad tadpoles will settle their identity. For by the latter part of June, the legs will suddenly develop, the finny swimming organ will disappear, and the young toads will leave the water never to return save for a brief period in the mating season. They are the veriest babies, however, when they first go abroad,

[1] Tiny chlorophyll-bearing plants.

and are so sensitive to heat that they hide under stones and rubbish, hugging the moist earth for coolness. But let a quick, drenching shower descend at the right season, and so many little toads will appear in gardens and walks, that it is small wonder that people once thought they rained down.

"In one way Mother Nature has been very kind to the baby toads. By making them so utterly unable to withstand the kiss of the sun, and thus forcing them to hide in quiet shelters, she shields them from their enemies the birds and snakes. And you should see what wonderful pains she takes with their toilets! Every ——"

"Oh, I have a piece about that, Uncle John," interrupted Ruth, in her little eager way. "Do let me speak it for you," and, permission being given, she recited the following lines:

A TOAD'S TOILET

Oh! the funniest sight I've seen to-day!
You'd never, never guess!
A queer little toad sitting under a leaf
Was solemnly changing his dress.

First, he took off his trousers (a very close fit),
As if getting ready for bed;
Then off came the sleeves of the little brown shirt,
And he drew the whole over his head.

He'd a fresh new suit underneath of brown,
With spots of lighter hue,
And gravely he looked himself over with care,
As much as to say: "Now I'll do."

Next he picked up his dusty cast-off clothes,
And folded and rolled them tight,
Then (no, I'm not joking) he swallowed the roll,
And slowly hopped off out of sight.

—Prentice V. Rogers.

"There are many such scenes in the life of the toad," Uncle John continued, as the generous applause ceased. "Frequently during the summer we find toads that seem much fresher and brighter looking than their neighbors. The reason is that they have just donned a new suit. In youth, the toad's skin is quite smooth. Roughness and warts come with age. The belief that the toad is poisonous arises from the milky acrid fluid it throws out from its skin when roughly handled. This does not affect the human skin, but dogs that attempt to bite toads show that they find the taste extremely unpleasant. It is no barrier, however, to hawks and owls, who never lose a chance at a toad. The toad is not quite grown up until its fourth year. At this period, the young females assemble at the ponds with their elders, and lay their first eggs. The number of eggs laid by the more mature toad-mothers is astonishing, their lavish provision be-

ing, of course, because Nature knows how many hungry mouths there are for tadpoles. Dr. Hodge, in his book *Nature Study and Life,* says that he once took 7,587 eggs from one toad and 11,545 eggs from another.

" Kirkland says that it is the irony of fate that large numbers of toads should be killed annually by man, who is the one most benefited by their lives. Countless young ones are slain by the lawn mowers, while the practice of burning over lawns and fields kills many more. The heaviest wrong, however, is that accomplished by small boys, like your grandmother's brothers, who know not the nature of the toad nor its rights.

" In England, where snails and slugs are more destructive than with us, the gardeners often protect themselves by founding toad colonies. And it seems that a toad farm there might do a thriving business, twenty-five dollars per hundred and even higher being paid for toads for colonizing purposes. Greenhouse owners in our country are beginning to realize the value of toads in their business, as the creatures are death to sow bugs, weevils, and rose beetles. I am sure ' Warty ' here will prove a very valuable addition to our rose garden, and no doubt you children can learn a great deal more about this policeman of the garden by watching him patrol his beat."

A NOCTURNAL HUNTRESS

"SH! girls," warned Max, as Mabel and Alice came laughingly out on the piazza in the early gloaming. "We are listening to the night-time orchestra. Hark to the little bell-ringers! They are out in full force to-night. Uncle John says if we want to see Warty to-morrow we will have to hunt for him down by the pond! There! hear that sturdy old throaty '*Clung! clung!*' I just know that's Warty. It sounds so sure and dependable."

"Nonsense!" Alice laughed softly. "Warty is no bass singer. I'll bet you anything that he pipes the highest tenor in the bunch."

"*Cling! cling!*" The notes wafted high, but softly, apparently from close beside the porch steps, and Alice had begun a gleeful "I told you so!" when Uncle John's smiling face took form in the gloom, and he joined them with shoulders which shook as much from his mischievous laughter as from the swift pommeling which Alice made haste to administer.

"If you folks *can't* keep still," growled Tommy, with a direfulness which needed no com-

pletion apparently, for it ended in a gruff gurgle. Girls were such nuisances sometimes!

"There's a new voice in the chorus to-night," Max whispered, linking his arm into Uncle John's and snuggling beside him, as the latter seated himself on the porch bench. "We can't make out what it is. We only hear it once in a while when there is a break between the toads' chimes and the crickets' chirps. It is a funny little sound, like a faint echo of Grandmother's old spinning-wheel. Tommy says that it is merely the accompaniment; every now and then along with it we hear a shrill clicking note, put in like punctuation marks, sort of grand opera style, you know."

"Yes," Uncle John nodded. "Very good description, I call that, my boy. I know your performer. It is the green grasshopper, or to be more exact, that particular one of the green grasshoppers known as the 'Longhorn,' so called because her feelers are so much longer than her body. She has one eye on her notes, and the other alert for passing prey. And every few minutes she interrupts herself to spring out and disembowel a victim. An extremely courageous huntress is she; for her prey is that colossus in the insect world which we erroneously term the locust. In truth, the green grasshoppers themselves belong to the locust family; our 'locust'

is a cicada or harvest-fly. There are many species of cicadas, but the one the green huntress usually lays for is a big, wide-bodied, prominent-eyed creature much larger and stronger than herself. But there is never any doubt about the outcome: the longhorn is too sly; she always takes her victim unawares, often as not springing upon it while it is sleeping. Being entirely unprovided with weapons, the poor cicada can do nothing but kick and cry out, and small good this serves. For the enemy is entirely without mercy, and her jaws are a stout pair of pliers which rip open the abdomen of the cicada in short order.

"Always the abdomen is the point of attack. We might think this the most vulnerable part of the cicada, but for one thing: usually it is the abdomen and its contents alone that are eaten. Now, why? We can form but one conclusion: the longhorn has a craving for the delicious sugary sap which the cicada imbibes by boring into the bark of trees with its handy little gimlet. Full well the longhorn knows where this treasure is stored, and she robs the syrup jar, so to speak. She does not care a great deal for meat, and the delicate walls and lining of the abdomen are quite sufficient. A cage of longhorns fed on cicadas soon comes to look like a slaughter pen, with the heads, wings, sundered legs, and empty carcasses of the unfortunate victims strewn all about. If

cicadas are not to be had, various beetles and cockshafers are made to suffice, and of these also the longhorn eats only the daintiest, tenderest tid-bits. After the green-clad murderess has had her fill of sugary pulp, meat and blood, she likes to reduce the heating effect of these by nibbling at a bit of fruit or some tender growing plant, thus managing by balancing her rations to keep herself always in the pink of condition."

"The longhorn and the katydid are the same creature, are they not, John?" queried Father.

"Not at all," his brother-in-law returned quickly, "though many people confuse them. The katydids lay their eggs on the young shoots of trees and shrubs, and make their home there, seldom if ever being found on the ground. The scale-like eggs which you may have noted arranged in a double row on the grape-vines in winter are katydid eggs. Longhorns and katydids are cousins, both belonging to the *Orthoptera* group. The green meadow grasshoppers are also included in the family. You all know them—long, slender, delicate green-colored creatures, matching in shade the plants they feed among. The longhorn is the beauty of the family, being a magnificent creature, slim and well-proportioned in spite of its large size. It is pale-green all over, with two whitish stripes running down its sides, great gauzy wings, and slender arching 'horns'

or antennæ extending backward above and beyond its body. It is strong in flight and is as much at home in the tree tops searching for sleeping cicadas as it is on the ground to which the strugglers usually tumble when the longhorn drives home her cruel thrust. The sudden, sharp insect wail which we sometimes hear in the dead of night is the poor cicada's shriek of fright and agony, which marks the longhorn's swift assault.

"The females of both the longhorns and the green meadow grasshoppers bear long curved egg-laying tools, sharp as pin darts. With these convenient ovipositors, they are able to make a tiny slit at the base of large grass blades and insert their eggs. Here in these snug little hatcheries the treasures are as safe as can be. No bright eye can hope to spy them; even bossy, if she passes that way, never bites low enough to disturb them. All winter they are sheltered by the grassy clump, and in spring the warm kiss of the sun presently brings out the baby longhorns. Thanks to the niceties of Mother Nature's time-table, they arrive just in time to furnish dainty breakfasts for the hosts of little quail babies that are hatching all about. A good many, however, manage to escape the bright little eyes in the fluffy balls of down, and the race of longhorns and meadow grasshoppers is never in any danger of being exterminated.

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THE "LONG-HORN" GRASSHOPPER

"Imagine what must be the feelings of the little chaps when they first hatch in their grassy clump. There is no father nor mother to guide them. Hunger demands that they must have food; but where is food to be found? I once passed one of these grassy nurseries and saw a score or more of anxious little heads peering out. I felt sure they must soon venture forth, and sat me down to watch. Pressed and harried by the clamoring brothers and sisters behind them, those in front were crowded out, and stood for an instant peering timid and half-frightened. What a big, big place was the world to which they had come! How was a tiny longhorn to know where to get a bite of dinner? Cautiously one of them nibbled at a bit of the short tender grass under its feet. Evidently it tasted good, for the next bite was taken greedily. Soon the whole household were busily engaged. Their mother, according to Nature's unvarying law, had carefully placed them in the very midst of the food their stomachs required for the first meal. I watched them scattering and feeding happily, each one daintily nibbling out little holes no larger than a pin-head here and there in the grass blades. A whole host of baby longhorns might feed in the meadow, I reflected, and the casual passer-by be none the wiser. I could not help a shrug over the thoughts of the havoc which a hungry beetle or

a quail bevy would create at the moment, should such a calamity pass that way. But, however much I would have liked to play guardian, I could tarry no longer. That evening as I returned, I peeped eagerly into the grassy clump, half-expecting to find it empty. But lo! there were the baby longhorns cuddled down in a little knot together fast asleep. Fate had been kind. Few, if any, of their number were missing. What would the morrow bring forth? How long would it be before they adopted the murderous calling of their mother, and ceased to go to bed at night as good folks should? I did not pass that way again for several weeks, and if the merry little goldfinch I found swaying on a weed stalk above the deserted home knew anything of the longhorns, at least he kept his own counsel."

QUEER CHIMNEY BUILDERS

AUNTIE and Alice had been spending the day in a city some miles away, going and returning on the trolley. It had been hot and very dusty, and the family were much surprised when Alice exclaimed eagerly: "I do wish the rest of you had been along; we had the loveliest trip! Something went wrong, and we had to stay quite a while near the most interesting little town. There wasn't a soul in sight, nor a house either for that matter; indeed no one would ever have thought of the place as a town at all, but for the host of little clay-chimneys standing here and there in every direction. Auntie and I got out and walked all through the place, but it was as still as the grave. Not even a single guard challenged us for the countersign! Such a queer situation for a town it was, too, away back from the river, in a low moist place, right beside the track. What they wanted to build so close up to the trolley for is a mystery; not one of the citizens ever takes a ride on the cars. Auntie said she thought it was because the special kind of clay they need for their odd chimneys happened to be right there."

"Crawfish Town! You stopped at Crawfish Town," cried Tommy. "Gee! I *do* wish I had been along. I don't see why something couldn't have *busted* the day Uncle John and I went up! We saw the town, but we whizzed right through. The citizens all work on the night shift, Uncle John says; that's why there was no one around. But I should think they would have had sentinels."

"You wouldn't if you got a close-up view of their chimneys, which of course you know are in reality their doors," Alice returned. "It would take a burglar with a very complete set of tools to get into their houses. Evidently they are well aware of this, and so go sensibly to bed and get a good rest in preparation for the night's hunt, when, under cover of darkness, their own movements are not apt to be questioned, and their prey is the more easily approached unwarily.

"The crawfish's house is all underground. Here he tunnels his rooms and galleries mole-fashion, bringing up his dirt to use in building his queer, chimney-style entrances. He has but one set of quarry tools—his pincer-like hands; hence he likes a particular kind of nice pliable clay to build with. Neither you nor I could cut a neater circle with a compass than the crawfish makes for his doorway. His chimney is in truth a little protecting wall about this entrance, and

he knows enough to make it firm and steady by building wider at the base. The chimneys are not very ornamental on close-up inspection, but they serve to keep out all uninvited guests."

"Crawfish are tireless hunters, working from twilight until morning is close at hand," Uncle John now informed. "Moreover, they are so fashioned that they can hunt with equal ease on land or in the water, having both the water-breathing power of the fishes and the air-breathing apparatus of the land animals. They walk about alongshore or on the bottom of the stream with equal ease. And stranger than all, perhaps, they travel backward even more swiftly than they go forward.

"Any time you might succeed in surprising a crawfish, you could easily knock his eyes off with a stick, not because they are bulging with fright, but because they are just made that way. They are thrust out from the sides of his head on queer little sticks, and so arranged that they turn readily in any direction. Naturally it is next to impossible to catch the crawfish unawares. Corner him and reach swiftly, but your fingers only close against one another; the crawfish is off at one side laughing at your failure.

"Another thing that is decidedly peculiar about the crawfish is that he wears his bones on the outside. And it is a very clever arrangement,

for they serve him not only as a skeleton to hold his body in shape, but as a coat of mail. To be sure, his skeleton is not made up of bones just like ours, it is fashioned in the form of plates, and while it serves double duty it yet has its disadvantages. For instance, when we meet with an accident, we may possibly break a bone; the crawfish has his crushed, because there is no cushion of flesh to deaden the shock.

"The crawfish is a flesh eater. Moreover he is not at all particular about his meat being fresh; indeed, if the truth be told, he would a little rather it smelled to the high heaven, and he will go long distances to obtain a taste of a delectable bit whose odor is borne to him on the winds. For this reason, too, he is easily trapped with a bait of decaying, ill-smelling flesh. He has many enemies among mankind, especially in the low countries. They say he is a mischievous creature, which of course only means that the crawfish's patient and persistent industry frequently conflicts with the plans of man. He will occasionally cut holes through dykes and dams, and sometimes causes dangerous and costly breakdowns of water barriers. Not infrequently, too, he varies his meat diet with a bit of green stuff, and thus causes serious damage to tender young crops. But the crawfish is not maliciously wicked. He follows his own even course in the pursuit of life and

happiness, and by retiring from the field during daylight hours does his best to live peaceably among his neighbors.

" Crawfish towns are scattered pretty well over the world. But there is one thing on which the crawfish insists: he must live near fresh water. He has a big overgrown cousin, however, the lobster, a scavenger lover like himself, who prefers the salt water, and judging from his size, he certainly thrives well in it. There is but one slight difference in the general make-up of the crawfish and the lobster. That difference is in the tail. Both the crawfish and the lobster have fin-like tails. The lobster's is composed of three round plates; while in the crawfish there is a division in the second and third plates making five in all. Otherwise the difference in the two cousins is practically one of size and environment.

" The limy external skeleton of the crawfish resembles a crust, and as he is a typical specimen of a host of kindred, the name *Crustacean* is applied to the whole order. Other well-known cousins are the crabs, barnacles, sow bugs, and water fleas. All the crustaceans are remarkable for the ease with which they adapt themselves to various and widely different conditions of life. We find them living in fresh water, in the sea, on land, and as parasites. In Mammoth Cave is a species of blind crawfish which shows plainly that

it is a descendant of the forms outside which possess perfect sight. While most crustaceans are solitary, a few like the shrimp much used for food, and the barnacles, are to be found banded together in vast shoals. There are more than 10,000 species of *Crustaceans* known, and their value can scarcely be computed. The myriads of smaller forms constitute the chief fare of the fishes, and are thus indirectly valuable to mankind; while as natural scavengers all of the larger *Crustacea* are of vast economic importance.

"The crawfish in common with others of his kind moults, or sheds his crust, whenever it becomes too small for his body. While the baby crawfish is growing up, it moults frequently; later on in life the moult occurs but once a year. When about to don a new suit the animal retires to a secluded spot. It is a sorry bother, and bound to be more or less ludicrous. No doubt the little creature is quite wise in avoiding the eyes of others. After a few days of hunching with arms akimbo in the general discomfort of an extremely tight-fitting suit, the seam between the carapace and abdomen finally gives way, and the crawfish after many wriggles and contortions finally manages to slip out of the old shell. His body is now soft and unprotected, and he is, moreover, so tired and weak from his exertions that he is an easy prey if any enemy chances upon his retreat.

He stays still and quiet, and gets through the days somehow in the deepest meditation. Generally at the end of a week he has formed a new crust or shell, and is ready to take his place once more in the affairs of the town. After all, perhaps, the whole incident is no worse than the trouble many a poor fellow has over his tailoring difficulties, myself included. Look at this jacket now: there are four buttons off!

"Crawfish reproduce by eggs. These remain attached to the swimmerets of the mother; and thus she carries them, and also the young in the early beginning of their career. When set adrift to fend for themselves, crawfish babies are tiny miniatures of their parents. They remain in the water until they have reached the age of discretion, and are ready to found homes of their own in Crawfish Town.

"One species, which resembles our town dwellers, does not follow all the latters' habits. It is found in our running streams and ponds, and spends its life in pools of fresh water. But, as said before, while the Crawfish tribe looks alike, there is no accounting for the vagaries of some branch of the family."

A CLEVER LOCKSMITH

"JOHN, you pride yourself on being a rather clever locksmith, don't you?" queried Aunt Ruth, tactfully. "I wish you would please see if you can fix the lock on the linen closet door. Something's gone wrong with the mechanism, and I don't like the idea of leaving the door ajar at this season of the year. I killed three clothes moths on the back porch this morning. Some way I had the feeling that every one of them had heard about that door, and were just watching for a chance to flit up the stairs."

"Locksmith! I say," exclaimed Tommy, catching eagerly at the hint of craftsmanship, "there's a trade we haven't thought of! But, of course, there are no locksmiths among Nature's corp of laborers."

"Indeed there are," affirmed Uncle John, stoutly. "And one of the cleverest of clever little people in the bargain! The trap-door spider. I meant to tell you about her this evening. I was reading about her a while ago. She is a tropical species, and quite as ingenious a miner as she is a locksmith. Her retreat is a shaft sunk in the

ground about twelve inches deep and an inch across. This shaft is very neatly and luxuriously lined with a fine silken lining, the product of the spider's own spinnerets. Here the young hatch and live for a few weeks until they are old enough to make burrows of their own, and here the mother rests when she is not upon the hunt.

"Usually the nests of the trap-door spiders are found in pairs; however, there is some doubt as to whether these are occupied by the different sexes or not. But, knowing how touchy and irrational most spider females are, we should think it a very wise provision indeed for the husband to have a den of his own, especially one like the trap-doors fashion; for so clever is the little door with which they barricade their shaft, that when once the spider is inside on guard, holding the door down by means of its mandibles and feet, no enemy, no matter how bloodthirsty, can break in, unless it is strong enough to destroy the door. In such case, usually the would-be murderer has his effort for nothing; the spider is out and gone by means of a second trap-door, provided for just such an emergency.

"The trap-door spiders are large and hairy and are close kin to the tarantulas. They are fitted with a third claw which aids them in climbing the silken lining of their burrows, and they have, also, a special raking-tool or miner's pick

for dislodging the earth in their construction work. Always the site chosen for their home is in a sloping bank, and the task of digging out the tunnel is laborious enough. But it is gone at with a will, the dirt being loosened fast and furiously, rolled into a ball, and thrown out with the strong, spiny hind-legs. One observed took an hour to dig a hollow about the size of a hickory-nut.

"Once the tunnel is completed, the next job is to coat the walls thoroughly with saliva. This mixes with the earth and forms a cement which is thoroughly water-proof, and so firm that the entire nest is often dug out and carried away by collectors. Different types of the trap-door spiders build differently, but the past-masters of the clan all build branched tunnels, the palm going to the species, which, as soon as one shaft is finished, builds another leading upward from the bottom of the first, the whole construction when completed forming an angle like the letter V. Small hope is there of every waylaying this latter wise little denizen in her burrow! Should an enemy manage to step in at one entrance, the other shaft offers a quick and speedy avenue of retreat.

"Now as to the door itself: there are two types of trap-lids built. The simplest of these is termed the *wafer* type. This is merely a thick flap, composed of silky thread, firmly cemented with earth and saliva to make it strong and water-proof.

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TRAP-DOOR SPIDER AT ITS NEST

But it fits perfectly, overlapping the edge of the tunnel carefully all around. The little worker knows full well that, if there are any cracks or chinks, water will soon come in and flood out herself and her babies. The second, or *cork* type of door, is a thick stopple with carefully beveled edges, which fits into the opening as neatly as ever a cork fitted a jug. Some species build a folding trap-door of the wafer type; in this case the two halves of the door fold back on either side. When closed, the line where they meet in the middle is absolutely straight and tight, by which it is plain that the little builder adds a master knowledge of the carpenter's craft to her other accomplishments.

"Nor is this all: she is a graduate in the school of camouflage. For once her trap-door is constructed, be it plain wafer, cork, or folding in type, she proceeds at once to disguise it so cleverly that not one in a hundred would ever sight it as a door, or dream of the home which it conceals. This is done by gluing over its surface an apt copy of the surrounding character of the bank itself. Bits of dead leaves, mosses, pieces of grass, tiny stones, even an accidental 'stick' thrown in helter-skelter helps in the concealment. So cleverly is it done that how the spider herself knows her own door, once she leaves it, is a mystery which only she understands. But she never

errs; moreover, when hotly pursued, she can dash up at a run, and disappear inside in a twinkling. Wise men say there is a very ingenious 'door knob' in this clever little door; one that human eyes cannot discern without the aid of a glass. It consists of two little holes into which the spider deftly thrusts her legs and pulls up the door; once inside, these legs are again thrust into the holes and the door drawn shut.

"The hinge of this fairy door is the final triumph of the little worker's skill. It is made of layer after layer of strong, silky thread, thousands upon thousands of strands, all woven closely together, and then bound on one side to the door, and on the other to the shaft. Indeed, there is really no 'join' on this latter side, for the deft hinge is in truth a continuation of the same silk which lines the little home. The hinge works perfectly, with never a creak or a bind, and withal the little door is so light and moves so freely that the spider easily lifts it with her head when she wishes to come out.

"On a certain occasion experimenters at San Diego, California, carried away the lids of sixty trap-door nests one evening. Next morning each spider had a new door fixed securely in place. The trick was played again and again. Each time the poor victims replaced the lost door, but with each rebuilding the workmanship decreased,

owing, it was plain, to the diminished state of the spider's silk. Finally, the fifth door was built almost entirely of mud, with scarce enough silk to hinge it properly, and the ill-used spiders were then left in peace. But yet man's 'ingenuity' suggested another test for the skill of the little trap-door householders. Going on to a new locality, the trap-doors were securely fastened down. Were the little locksmiths imprisoned in their homes? Not at all. Each and every one built a branch tunnel, and opened a door from it.

"The eggs of the trap-door spiders are placed in a little silken wall-pocket inside the burrow. The food of these spiders consists largely of ants and other small wingless creatures, though they do not despise a good juicy earthworm, or a fat caterpillar."

A RASCALLY HUNCHBACK

"SEE here, Uncle John," Tommy began, fishing in his bulging pocket for the wherewithal to point his remarks, "I've been on what Ruth calls a 'detecting tour,' and I want you to explain what this means. Alice says it looks like the hieroglyphics of some insect Ku Klux Klan."

And the lad laid on the table a miscellaneous collection of green cherries, plums and small peaches, each one bearing the following strange cabalistic sign heavily stamped on the side:

"Ha!" ejaculated Uncle John, sharply. "Where did you get these, boy? Not in our orchard, surely."

"No, sir. They came from that little old neglected garden of the Widow Trueblood's. But why are you so certain they could not have been found on our premises?"

"Because we wage a heavy spray campaign every year against the rough customers who make a business of going about despoiling fruit

with their free-hand designs. After they have had a good bite of arsenate of lead naturally they do not care much about arts and crafts! The perpetrator of this careless deed is a wicked little humpbacked dwarf called the plum curculio. The word *plum* is a misnomer, as you can see by your collection. In truth, if any special name were to be given the hunchback, *apricot* curculio would be the most fitting, as it really prefers the apricot to anything else. However, the first scientist to discover it found it doing excessive damage to plums, and plum curculio it became forthwith. The name has clung, notwithstanding that every one now knows that the little wretch works not only on all the stone fruits, but on the apple as well.

"The curculios spend the winter under fallen leaves and trash upon the ground, the most likely place being little gulleys and 'pockets' where the leaves have drifted deep, and been thoroughly packed by the soaking fall rains. You might pry into such a den, and then never see the little hunchbacks unless you looked very, very closely. For they are dressed in a veritable tramp's garb, so dingy and soiled that their general grayish-brown blends in well with their surroundings. Even such bright-eyed little people as the quail and chewink—our forest chickens—will scratch over and over in a well-populated bed and never

discover the little hiders, so long as they lay perfectly motionless, which they are quite wise enough to do.

"At the first hint of blossom-time, the hunchbacks rouse up and hike for the nearest fruit trees. They do not have much appetite at first, but they nibble a little here and there at the young leaves and blossoms. By and by their sluggish interest warms up, and when the fruit begins to form, unless they have chanced into the trees of a progressive orchardist, they are in fine, hearty condition, and the mother curculio begins to lay her eggs.

"With her long snout she makes a small cut through the skin, running down into the fruit about one-sixteenth of an inch. In this cavity the egg is placed. Then, with wise foresight, the little mother cuts a crescent-shaped slit in front of the egg chamber, the object being to cause the fruit about the tiny egg to wilt, and thus prevent the crushing of the larvæ by the swelling of a fast-growing cradle. With so much food close at hand, the little white footless grub grows miraculously, and in from three to five weeks, when the fruit, shriveled and crippled by its voraciousness, falls to the ground, it is ready to vacate the useless hull. Quickly and surely it burrows into the earth to a depth of from four to six inches, and there takes its pupa sleep. The nap is not a long

one, however; in from three to six weeks the full grown adult, a wicked, miserable little hunchback, emerges, and joins the summer loiterers, drifting about hither and yon until the fast-falling leaves warns it to seek a winter bed. They are a single brood species, hence these beetles, while they feed on both fruit and leaves, do not lay any eggs until the following spring. Then the females hurry from fruit to fruit, ripping recklessly here and there with their destructive little snouts, each one making and stocking anywhere from two hundred to five hundred crescent-guarded cradles. Sometimes several eggs are laid on large specimens, like the apricot, the peach and the plum. Every time you find a ' worm ' in any of the stone fruits, you may be pretty sure that it is the grub of the curculio.

" The apple curculio is the least common of this great band of dwarfs, and by far the most humped and disfigured. Her snout is as long as her body, and she chisels deeply, striving to put her egg as near the core as possible. When the grub hatches, it at once begins to excavate a tunnel toward the heart of the apple, and if it succeeds in reaching its goal, the fruit soon stops growing, shrinks and shrivels, and at length drops to the ground, allowing the full-grown larvæ a chance to escape and pupate in its earthen cell, in the same manner as do the stone-fruit curculio.

But, if for any reason the apple manages to withstand the onslaughts of the grub and clings steadfastly to the tree, a strange thing happens. The grub, foiled in its usual method of escape, knows not how to combat the situation; it is not hungry, having reached its growth, and shortly it loses heart and dies. Little by little its body is absorbed by the growing fruit tissues. Its trail, however, never altogether disappears. Perhaps some time when eating an apple, you may have noted a thin streak of hardened, rather green-looking character, extending from the surface of the apple toward the core. This marks the progress of the little curculio in its attempt to outrun the growth of the apple and get at its heart. Failing in this desire, it was itself overcome and absorbed. Nothing remains but the faint trace of its tunnel.

"The time the curculios remain in their earth cradles depends not a little on weather conditions. If the season is dry and hot, they stay drowsily hidden away. If, however, heavy showers follow one after another, the hunchbacks hustle into their adult clothes and hurry up into the trees. As though they knew full well their own destructive character and the feelings they rouse in the bosom of the orchardist, they are exceedingly shy. One good shake of the limb on which they have settled, and they quickly let go with all six

legs and tumble to the ground, hoping there to make a neat get-away, by reason of their clever camouflage garments. This maneuver works less often than formerly, for man has learned this trait, and many orchardists take the precaution of spreading a trap for the beetles ere the limb is jarred. Usually, however, the spring spraying is calculated to take care of the curculios. If they get a nice breakfast of arsenate of lead shortly after awakening from their winter's sleep, they never live to injure the fruit."

SOME OF NATURE'S CHORISTERS

"WELL," giggled Alice, from the depths of the "Joke Column" she was reading, "listen to this: 'I hear they have the King of the Bullfrogs in jail.' 'What for?' 'Somebody heard him talking about smuggling a Jug-er-rum!'"

"So he did," Tommy laughed, delightedly. "I heard him myself, just last night, and the tidings seemed to create all sorts of commotion all over Frog Town. There were various deep-drawn '*Ker-chogs!*' Advice no doubt as to what to do with the Jug-er-rum! And then came a vigorous scoffing of '*Ker-peep, ker-peep!*' I'll bet you anything you like, they were hazing some peeper."

"Our reading lesson to-day was about a great frog parade," commented Ruth, her eyes shining. "And I'll bet you can't guess what the captain's steed was? A little green lizard! Yes, sir. And how proud they all were as they marched away after him! Their spears of marsh grass were over their shoulders. Water weeds made the fine plumes in their caps. Their flags had all grown in the pool. For trumpets they had the seed pods of the water-lily. And such music as they

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THE "NIGHTMARE" FROG

made! All the frogs kept perfect time, and as they went they shouted and sang. Wouldn't you just love to see such a parade? Our book says it is something no human eyes may ever see; for, let one but come near the pool, and down go all the frogs *kerplug!* But always, if we listen when the sun goes down, we may hear their trumpets blow. That's what *I* heard last night," and she looked at Tommy rather pointedly, plainly suspecting him of romancing.

"Isn't it true that we always get what we are looking for?" Auntie observed sagely. "As for me, I pictured a frog school as I listened to the medley, and said over to myself some old verses I have not thought of in years:

"Twenty froggies went to school
Down beside a rushy pool;
Twenty little coats of green,
Twenty vests all white and clean.

"'We must be in time,' said they,
'First we study then we play;
That is how we keep the rule,
When we froggies go to school.'

"Master Bullfrog, grave and stern,
Called the classes in their turn;
Taught them how to nobly strive,
Also how to leap and dive.

"From his seat upon the log,
Taught them how to say '*Ker-chog!*'
Taught them how to dodge the blows
From the sticks the bad boy throws.

"Twenty froggies grew up fast,
Bullfrogs they became at last;
Not a dunce among the lot,
Not a lesson they forgot.

"Polished in a high degree,
As each froggie ought to be;
Now they sit on other logs,
Teaching other little frogs."

"And I," contributed Uncle John, as Miss Merryhew turned obligingly to the table to write down the lines in response to the children's delighted request,—"I, in my dry and scientific way, simply catalogued the frogs as some of Nature's most delightful choristers, and then realized that I had hit upon a rather interesting group—Nature's musicians. How many of them can you name offhand—not counting the birds, of course."

"First of all," offered Mabel, "is the house cricket—the cricket of the hearth. Since Time began he has been pictured with the comfortable fireside and the steaming kettle."

"And there is no cosier note," commented Grandfather, briefly. "But alas! in these days

of perfect architecture and careful housekeeping, it is one heard far too seldom."

"The crickets get their name from the French word *cricri,*" Uncle John informed, "and they *are* a voluble race. Many of our field crickets are decidedly musical, but their music is of the shrill variety, pitched according to Scudder at '*e* natural, two octaves above middle *c*.' The cricket song most common in our vicinity comes from a tree species called the snowy tree cricket. Strangely enough, the number of the cricket's notes per minute varies according to temperature, running about one hundred chirps to sixty-five degrees Fahrenheit, and there is said to be a distinct difference between the day song and the night song. Riley interprets the day version as sounding a cry of *re-teat, re-teat;* while another writer says it is an invitation to *treat—treat—treat.* Burroughs loved this cricket's notes and spoke of them as a 'rhythmic beat.' Hawthorne called it an 'audible stillness,' and fancied that if moonlight could be heard it would sound like the snowy cricket's song. Little is really known about the life history of even our commonest crickets, and it must be full of interesting detail. You could gain an audience among the bugologists, Tommy, by working up some one of them. Suppose you try? I will help what I can."

"*Katy-did!*" The shrill call from somewhere

out in the shrubbery was decidedly early for the season, but most opportune, and the occupants of the Dayton porch laughed appreciatively.

"Score one for Katy," exulted Tommy delightedly, "even if she did!"

"Did what?" queried Ruth, round-eyed.

"Aye, what," Auntie murmured, "for ages we have been querying that. Isn't it Oliver Wendell Holmes who says:

"Peace to the ever-murmuring race!
And when the last one
Shall fold in death her feeble wings,
Beneath the autumn's sun,
Then shall she raise her fainting voice,
And lift her drooping lid,
And the children of future years
Shall hear what Katy did."

"I doubt if we ever know, chicken," said Uncle John, smiling at Auntie, and stooping to swing Ruthie up on his knee, "Dr. Holmes to the contrary notwithstanding. He was a very wise man, but he did not know much about katydids, that is certain, for he proclaimed:

"Thou art a female Katy-did!
I know it by the trill
That quivers through thy piercing notes,
So petulant and shrill.

"And all who know katydids know that the females never make a sound! Whatever it was

that Katy did,—and it must have been something awful, judging from the clatter that has sounded down the years,—her own sex, at least, do not deride her. The charge comes from the male members of the clan, who voice their convictions by rasping their wings over an odd rounded membrane which is fitted with file-like teeth. The effect is harsh and strident and carries on the still night air so as often to be heard more than a quarter of a mile away. Occasionally some particularly vehement performer will proclaim loudly, 'Katy *she* did!' Then all the other katydids in the vicinity, refusing to be outdone by such triumphant exhibition, immediately sound the accusation in like measure 'Katy-*she*-did! Katy-*she*-did!' The confused medley is laughable, if nothing more. Some folks think that they are calling, 'Katy *didn't.*' It does, in fact, sound like a constant squabble to me, as to whether Katy 'did' or 'didn't.'

"There is a good deal of disagreement about the musical character of the katydid's performance," laughed Uncle John. "He is an instrumentalist, not a vocalist, you understand, and his 'music,' despite its questionable wording, is very probably a love song. Some writers recognize a quaint melody in his notes, others say his song is grating and disagreeable. Scudder proclaims that the poets who have sung the katydid's praises

must have heard him at the distance that lends enchantment.

" The katydid is close kin to the grasshoppers and the crickets. It is strictly an American species; no such performer being found in any country across the sea. There are several types of katydids, the broad-winged species being considered as the ' true ' katydid. This species spends its whole life in the densest foliage of tree, shrub, and vine, and is more often heard than seen. Indeed, one needs must look pretty sharply to find it, for so closely does it resemble the foliage it dwells among, that it is scarcely discernible when motionless. Their food consists of leaves and tender twigs. If they were present in such numbers as grasshoppers frequently are, they would do no little damage. But they are a solitary tribe, and prefer to dwell alone save for a brief period at mating time.

" The eggs are laid in September or October, in little double rows along the surface of small twigs. There are eight or nine eggs in each row and they overlap one another like the shingles on a roof, being fastened to the twig and to each other by a special gummy substance of the mother's own manufacture. They are impervious to storms of wind and rain, and Jack Frost has no power with them. In May, the young come forth, looking much like their parents save that

they have no wings. As they grow in size they shed their skin, and with each new garb the wings show more and more, until after the fifth molt they appear fully developed, and the young katydids are now grown up. This is usually about the first of August, and now one whose ear is tuned to Nature's sounds will frequently hear a new beginner lisping '*Katy! Katy!*' His instrument seems to require a good deal of tuning and scraping before he finally brings out a triumphant '*Katy-did!*' But when once he has the plaint in motion, he is capable of keeping up the sound monotonously all night long. Katydids seldom sound their notes in the daytime. To do so would be to reveal their hiding-places to the birds, and be, in brief, little short of plain suicide."

"Self-defense, no doubt, explains why so many of Nature's small choristers prefer to sound their lays at night," Auntie reflected. "Little intermediate sounds many of them are, for the most part scarce sounds at all. They would pass all unnoted in the day's busy turmoil, but at night when all is still they add full measure to the peace and charm of the quiet eveningtide. Cowper puts the thought most pleasingly:

> "Sounds inharmonious in themselves and harsh,
> Yet, heard in scenes where peace forever reigns,
> And only there, please highly for their sake."

AN APPLE THIEF

"UGH!" Tommy ejaculated, hurriedly ejecting the bite of apple which he had taken in too great haste, secure in the belief that their apple boxes contained none but perfect fruit. But alas! he had unwittingly dipped into a box of "seconds," which Mother had saved to work up, and he eyed ruefully the tiny dirty-white worm lying all crumpled in the palm of his hand. "Here's a nasty little apple thief, Uncle John," he sputtered scornfully. "Can you name him?"

"Codling-moth," was the brief reply. "His color identifies him. There's another apple thief, known as the lesser apple-worm, which looks much like this fellow. But it is pink at all times. When full grown and ready to leave his luscious apple house, the codling-moth larvæ is quite pink, too. However, the little dots of black along his back always distinguish him."

"But I thought we sprayed twice for codling-moths?" Alice ventured, uncertainly.

"So we did," Uncle John affirmed. "But no matter how thoroughly the work is done, enough specimens always survive to make the fight an

endless one. Codling-moths cost the fruit growers of America at least ten million dollars annually. They work in the hearts of apples and pears, and for every fruit that manages to survive the attacks of these little thieves and develops sufficiently to come to the mouth of a would-be feaster, there are bushels which are entirely ruined, and fall to the ground undersized and worthless."

"I know codling-moth eggs," volunteered Tommy. "They are like very tiny drops of milk, no larger than a small pin-head and slightly flattened in shape."

"Only when strictly fresh are they pearly-white in color," Uncle John corrected. "Within a day or two they begin to show slightly reddish, owing to the fact that the little thief inside is beginning to grow. In a week or ten days it is out, a tiny creature not more than one-sixteenth of an inch in length, seeking eagerly what it may devour. And anything is grist which comes to its mill, whether it be leaf or fruit. Shortly, however, it develops a decided preference for fruit, and instinct directs it to the blossom-end as the easiest and most suitable entrance.

"Now you know what the blossom-end of a young apple looks like. It is filled with a tiny cluster of tender leaf-like projections—all that remains of the calyx of the apple blossom. To

the tiny worm these little lobes are a veritable protective forest, and it slinks gratefully in among them, knowing full well that here it is safely hidden from the many bright eyes that are in turn peering eagerly about for food. And here the little worm tarries for a time browsing on what we may well term the shrubbery of the forest. Now, if the orchardist has been forehanded, the worm shortly fills his stomach with the tiny particles of spray dope that have been scattered there, and he dies without doing any noticeable damage.

"It is important that the blossom-end of the fruit be filled with the poison at a certain stage; for the tiny forest does not long remain free and open, the little lobes of the calyx draw tightly together, and the way to the heart of the apple is securely closed. The little apple thief knows how this will be, and at the first warning of shrinkage in its tiny pasture, it slips inside the door, and begins a courageous tunneling toward the core of the fruit, knowing that there it will find tiny growing chambers well-suited to its individual needs. Imagine yourselves shut into a tight little room filled with meat and drink, with nothing to do but to eat your way out when you got ready! There might be drawbacks to the situation, but the little apple-worm discerns none. Safe and secure it feeds and grows lustily.

"Not all of the little pests grow up in the same time; some may take but three weeks, others may be a month or more at the business. One and all, however, reach a day when their prison house becomes intolerable. With prompt dispatch they set about tunneling toward the surface; but they do not pop out the moment they have cut a doorway. Something warns them that it is never wise to be in too great a hurry. Therefore, a halt is called, and a little plug woven of silk and refuse is made to stop up the exit. Behind this barrier the apple thief takes counsel with itself, and no doubt carefully plans out an exact method of procedure. If it happens to be a bit slow-witted, it may occupy several days in calm deliberation.

"Then, sure of itself, it quietly opens its door by pushing out the plug, crawls out across the fruit, and, if unmolested, proceeds serenely by way of twig, branch, and limb to the trunk of the tree. Here it moves more slowly. It is house-hunting, and presently a site is found which seems in every way desirable. Usually this is under a bit of shaggy bark not far from the ground. This is one of the reasons why the good orchardist takes care to keep the trunks of his trees in smooth, perfect condition. Well he knows what harbors rough and tattered bark affords!

"Safe inside its chosen refuge, the apple-worm

winds itself in a silken cocoon and rests from its hazardous journey. How tired and sleepy it is! Food is not necessary now. Utterly relaxed and motionless it lies for days on end, simply waiting for Time to work its way with it. In about three weeks Nature triumphs; the skin of the hard little brown object, not more than half an inch long, into which the worm has been turned, now splits down the back, and out comes the full-grown moth from its pupa case. As Riley puts it, its wings are 'still damp with the imprint of the great stereotyping establishment of the Almighty,' but they are soon dried. And once the crumples are fully shaken out, the moths soar madly away to test their power. They soon find their mates and swirl about in a gay honeymoon which is as brief as it is rapturous.

"Mrs. Codling-moth is a decidedly plain-looking little person, with a wing expanse of about three-quarters of an inch. The bridegroom is a trifle smaller, and both of them are so nearly the color of the apple-tree trunk that it takes a good eye to note them against it, so long as they remain motionless. The young of these codling-moths hatch about the first of July. Of course, it is too late to think of getting into the apple pantries by way of the door in the calyx grove. This is now tightly locked and double-locked. But the little thieves must get in, and they lose

no time in pondering over the matter. They begin to tunnel right where they land, and this as often as not is in the side of the apple. Unless the orchardist has taken the precautions to give the fruit a thorough covering of spray dope—we use arsenate of lead—the worm is not long in burying itself from sight.

"Thenceforward its career is the same as that of its parents, with this difference: Ordinarily, when the second brood leaves the shelter of the apple, the season is near its close. They get themselves into some carefully secluded shelter and prudently wrap themselves up warmly there to sleep through the winter in their pupa cases, emerging in the spring about blossom-time. Of course, there are always certain specimens, like the one you have found, Tommy, which are so belated that they meet death in their luscious nurseries. In some localities, when spring opens unusually early, three broods of codling-moths are registered."

A BAND OF PIRATES

"SUPPOSE we go down to the pond," suggested Uncle John, wisely taking the initiative in choosing a spot for their half-holiday. "There is a host of little people there of whom I never tire. First of all, basking in the warm mud along the edge are the little frog tadpoles, a small black legion of divers interests. Close in among the reeds are the little fleets of caddis submarines, than which no boat is more ingenious. Near by the orange-bellied newt carefully holds to his course by means of his broad rudder-shaped tail, and in the deep places the water beetles, those crafty pirates of the pond, dive alertly carrying with them an extra supply of oxygen in an air-bubble held at the tip of the wing-cases. Whirling dizzily on the surface in curious twists and curves are the whirligig beetles; while hard by the pond-skaters glide swiftly along with funny side-strokes such as you boys can never hope to equal. Likewise, there also are to be found the water-boatmen, those queer creatures whose heads are so lightly attached to their bodies that they almost seem to float free of them, and the flat-

water scorpions, and dragon-fly grubs, not to mention the plump pond-snails, leeches, and the little canoes of mosquitoes-to-be."

"The pond! the pond!" shouted Tommy and Max enthusiastically, notwithstanding the fact that two-thirds of their spare time was always spent at this interesting retreat. "But," Tommy naively explained, when some one mentioned this fact, "we go swimming then!"

To be sure! You boys all understand how that is: you are so busy having a perfectly delightful time yourselves that you give small heed to the affairs of the tiny water dwellers whom your antics have doubtless driven to cover. If you mean to get acquainted with pond life, a trip must be made for that purpose alone; this the Dayton boys well knew, and they lost no time in doing their part to get the expedition under way.

"Please let's not waste any time on tadpoles," begged Alice, on arriving at the water's edge; "we all know *them*. Let's look for the caddis submarines. 'Stones that move,' one authority terms them; but I've never been able to find anything of the sort. The ones I have taken up on suspicion are never anything but plain old pudding-stones."

"Not all caddis submarines are built of stones," Uncle John informed. "Indeed, the

most common one of all is built of stiff roots, which have long steeped and peeled under water. The caddis worm, which as you may know is the grub of the caddis fly, is a clever spinner and weaver. Having gathered sufficient bits of root material it proceeds to fashion them into a tiny tube-like basket of wickerwork; then to make the whole thoroughly water-proof it plasters the chinks with a cement made from saliva and fine grains of sand, with bits of leaves thrown in to take the place of the hair used by plasterers. Next in order are the decorations, which follow the old homily 'Beauty is not all in seeming.' They consist of a little row of spikes, fashioned of tiny sticks cut exactly the same length and set up all around the edge of the basket, serving not only to enhance its attractions, but to give it strength and at the same time to afford protection. Ingenious enough they are, but they make the little craft hard to steer, and when the worm gets heavier it is often obliged to forsake this boat and build another of lighter materials.

"There are something like one hundred and fifty species of caddis worms in our country; naturally they build a wide variety of homes. Some prefer simple little flat basket boats; others build a triangular design; the least common species of all fashion a silken horn, which tapers to a sharp point. Not a few of them decorate their

dwellings with tiny snail shells, those having living inhabitants being preferred, as their own habitation is thus more likely to escape detection. The simplest homes of all are those built by the caddis worms hatched in swift-moving streams; these are merely a few sticks and pebbles glued together and fastened to the lower side of a stone. The most elaborate caddis dwellings are built of mosses, leaves, and sand, run up in the form of a tall chimney, with a door at the top. Fabre's caddis worms built magnificent ivory palaces in his aquarium from the rice grains which he supplied."

"Hi!" exulted Tommy, whose bright eyes had been busily alert, and he bent swiftly over almost on the instant, snatching up a little bunch of pebbles which held securely together, but which *failed* to disclose any sign of occupancy. "The thing moved, I *saw* it!" ruminated the boy, as he studied it closely. "It went right over a tiny snail, and when it had passed the snail was gone! But there isn't any door that I can see; nothing at all, indeed, by which the craft, if it *is* one, could be moved."

"What about that tiny crevice there?" suggested Uncle John, pointing to a little rift between the two "front" stones. "Suppose you pry those apart with your knife."

Quickly Tommy acted upon this advice, and

the secret of the pebbles yielded into his hand—a nice fat caddis worm.

"You see," observed Uncle John, "self-preservation warned him to withdraw into his stronghold when he was snatched up so rudely. Ordinarily he keeps his head and front legs sticking out his door, the latter being used as paddles, and in this manner he tows his little house-boat along. Being white, his person merely sparkles like a tiny point of light, and he is all unobserved by human eyes, but not thus easily does he pass among his neighbors. Always as he sails slowly about fishing for a living, he must keep a wary eye out for the foes who fain would make a meal of him.

"Many of the caddis worm tribe spin webs as the spiders do to trap their prey. These web nets are slung across an opening between two stones, and open up-stream. Here tiny minnows and other water prizes are taken before they so much as guess their danger. Not a few of the house-boat builders, however, are almost entirely vegetarians. They feed upon the foliage of the water plants. If you keep your eyes open this afternoon, it is just possible that you may chance upon one of these interesting little specimens laboriously towing its boat after it as it climbs up a plant stem. It will browse about a bit, and sun itself, then drop quietly back into the water.

"These clever little folks are able to float at will along on the surface of the water. They are not very skilful at their oars, to be sure, but they can turn and tack about and get along well enough to suit their needs. They can also dip down with surprising suddenness, stopping at any desired depth in the water. How do you explain this? The worms themselves are helpless looking, as you can see by the specimen Tommy has captured.—Ah, don't throw him away, boy," as Tommy's arm was raised to deposit the unfortunate worm in the water. "Take him home with you, and watch him build a new submarine! You can put him in a glass jar, and supply him with whatever materials your fancy pleases.

"His old boat is too badly wrecked to be seaworthy, but even if it were not, I can assure you that it would not float without the boatman. However does he manage? Let us see: when at rest in the bottom of the pond his plump little body comfortably fills his boat. Suppose he takes a notion to go to the surface and have a look around. Apparently he cannot rise unaided; he climbs slowly up a reed stalk, painstakingly dragging his boat along after him. Once at the level of the water, he sticks the front of his body out of his sheath, leaving a vacant space in the tightly-closed rear of his boat, which like the vacuum in

a pump when one draws out the piston, promptly fills with air, and presto! the worm is able to float about to suit his pleasure. The air in the stern, you see, buoys up the little craft, just as the air in a life-preserver holds a person up in the water. If an enemy approaches, or if for any reason whatever the worm wishes to go below, all he needs to do is to draw in his body, thus expelling the air, when his little submarine sinks instantly. Progress downward is controlled by the action of the occupant: he can stop any time he pleases simply by thrusting his body forward and out, thus taking on a ballast of air."

"Seems to me the caddis worm should be reasonably safe from enemies," Alice commented musingly. "Few creatures, I imagine, would think of swallowing a bunch of floating sticks or pebbles!"

"You forget that the eyes of the water creatures are sharper than ours in some respects," smiled Uncle John. "They know the caddis worm's habits, and not a few of them are always on the alert to catch him unawares. Wait! I believe we can have some good sport," and Uncle John in his turn stooped and brought up a little caddis boat. Then he beckoned silently and moved quietly alongshore until he reached a fair-sized rock which jutted out into the water. From this broad vantage point a group of shiny black

creatures, all of an inch and a half in length, were diving like schoolboys into the depths of the pool.

"Water beetles!" exclaimed Uncle John briefly. "See the little bubbles of oxygen at the edge of their chests, shining like little silver breastplates? That's what makes them so agile in the water. Now watch!"

His good baseball arm sent the little caddis boat spinning lightly along on the top of the water to sink just short of the busy little divers. Instantly one and all were at attention, and they waited with a tenseness which failed to detect the watchers alongshore. Nor were they kept long in suspense. Evidently the caddis worm was puzzled at such a strange procedure, and in due course it came laboriously up a weed stalk near at hand to reconnoiter. A trifle dazed it must have been; for, ere it was aware, it had launched out into the very midst of its enemies. Quick as they were to seize him, the caddis worm was even quicker; indeed he jerked back into his house so quickly that, as Alice observed, they almost heard the door slam!

But the pirates were in no wise daunted; plainly they had often met with just such a rebuff. All of them bent to the task of breaking the small boat in pieces, pulling viciously this way and that, and striving desperately until there was a sharp rending, and the tiny shells which

decorated the boat crumbled in their grasp. But if they expected to get the caddis worm then they were mistaken. Too well and carefully had his house been woven and cemented; it would take yet more vigorous pressure, and the villains braced themselves and prepared to squeeze with might and main.

Then a joyful thing happened; for, all suddenly, as the pirates strained with down-bent heads, the watchers saw the house door open a crack, and then the caddis worm slipped between the feet of the would-be murderers and sank out of sight amid the reeds. Nor were the rascals aware of the little tenant's escape! They continued to press and tear until the walls at length gave way, and they found to their chagrin that the boat was empty.

"Ha!" scoffed Max, "you boneheads! Served you right; next time you want a lunch, try to earn it honestly," and he tossed a stone sharply into their midst, scattering the villains instantly, to the disgust of Tommy, who had, of course, hoped to obtain a specimen.

"There are around four hundred species of the water beetle clan in our rivers and ponds," Uncle John informed. "All of them are past masters in the art of swimming and diving and are piratical to a degree, being fitted with strong mandibles which are supplied with a suction apparatus, thus

enabling them to feast gluttonously on the juices of soft-bodied water creatures. The females cover their eggs with a cocoon of hardened jelly-like stuff. This cocoon has an inner and an outer case, and is attached to a curiously shaped floater. The larvæ are the bloodthirstiest little pirates imaginable, eating insects and snails, and when these are scarce, preying upon each other. They pass their pupal stage in the ground.

"The whirligig beetles which I mentioned are close kin to the water beetles, being small oval forms whose lives are certainly one mad whirl. They can dive in pursuit of their prey, if need be, but as a rule their lives are spent circling dizzily on the surface of the water. Some three hundred and fifty species have been catalogued, but only forty of these are known in our waters. Like the water beetles, they have sharp mandibles and an unappeased appetite."

"What about the water boatmen, I think you called them?" queried Alice. "Are they beetles, too?"

"No, they are mottled, oval-shaped bugs, and decidedly queer specimens, being one of the few aquatic musical performers, playing a smart tune on their snout with their fore legs. Their hind legs are oar-shaped, and they swim rapidly, being able to chase their prey above or below the surface, as they carry down with them a film of air

held by the fine hairs which cover the body. When cold weather comes on, in common with the other creatures of the pond, they sink to the bottom and hibernate in the mud. If perchance their pool dries up in the heat of summer, they take to their wings and hunt a new location. While en route on this business, they are frequently attracted by an electric light and swirl blunderingly about it with moth-like insaneness. The beak of the water boatman is sharp enough to pierce one's finger, and the effect is much like that of a bee sting. The eggs are attached in masses to the under water stems of plants. Mexican Indians and half-breeds are fond of these eggs baked in a cake with meal. They are said to have a pungent acrid flavor. The boatmen themselves are shipped by the ton to England as food for game birds, poultry, and fish, one ton containing around twenty-five million of the insects.

"Closely resembling the boatmen is another queer race of bugs called the back-swimmers, but they are easily distinguished, as these creatures always swim flat on their backs with their belly upwards. Then, too, they carry a large ballast of air below with them, and are obliged to hold fast with their fore legs to some stone or a water plant to keep from rising. They are pirates of particular strength, being able to overcome a

good-sized minnow. The females carry stout little egg-laying tools, by which a slit is made in the stems of water plants and the egg mass thrust partly inside for safe keeping. Probably if we look about among the water plants and rushes we shall be able to find a back-swimmer's nursery."

It was a happy suggestion, and one which shortly brought results; for Max's eager eyes located a pierced stem with its trailing decorations, and he hauled it triumphantly forth.

"Well done," ejaculated Uncle John, but as the stem came to his hand his expression changed, and he drew a magnifying glass from his pocket, asking each one to observe the nursery carefully. He waited expectantly, but, though there were plenty of comments, the point he hoped would score escaped the eyes of all, not even excepting Tommy, who was fast becoming no mean observer. "I thought you would see it," he said, then, a bit disappointedly, as the glass and stem came back to him. "How often must I tell you never to take anything for granted? Does this nursery tally exactly with the description given for that of the back-swimmer's?"

"Why,—y-es," stammered Alice, "a slit in the stalk, part of the egg mass inside and part hanging."

"Was that your impression, Tommy?"

"Well, no," observed the boy slowly; "to me

it seemed as though the egg mass were *all* inside; the part hanging looked like mere streamers or decorations of some sort."

"Why didn't you *say* so, then?" Uncle John queried, relieved. "For what you observed betokens that the nursery does not belong to Mrs. Back-swimmer at all! It is the property of the water scorpion, and of a particular one of the scorpions,—*Madam Ranatra*. There are two species in this interesting family. *Madam Ranatra* is long, thin and slender. Her nursery is always embellished with seven streamers. If we were to sever one of these, we should find that it is in truth a little air-tube. Its function is not altogether certain, but doubtless it supplies free ventilation to the eggs and later to the tiny youngsters, and further affords them a safe passage into the water.

"*Madam Nepha* is the other member of the water scorpion tribe. She is flat and oval and as unlike her cousin *Madam Ranatra* as it is possible to imagine. They have, however, several features in common: their fore legs are swollen and fitted for grasping; at the anal end of the body each bears two tail-like hollow tubes; when united these form a circuit to convey air to the insect while the rest of its body is under water. Both are pirates of great ability, attacking small fishes and other water insects. *Madam Nepha's* nurs-

ery is distinguished by the fact that there are but two floating streamers.—Goodness me! is that the supper bell?"

"It surely is," bemoaned Alice, "and we haven't half exhausted the inventory you gave us in the beginning."

"Well," Uncle John laughed comfortingly, "the pond will be here all summer; so will its chief citizens. We needs must make a dozen or so trips anyway, if we would be on speaking terms even with half of the population."

LITTLE AIR POLICEMEN

"WHEN can we go back to the pond?" queried Alice, a few evenings after the expedition which all had enjoyed so thoroughly.

"Some time in the next millennium, judging from the stack of work before me," Uncle John returned ruefully. "However," he added more cheerfully, as he noted the dismay in the faces about him, "there's no reason why we can't have some of the leading citizens brought up here. Tommy, do you know the 'nymphs,' as some call them—those comical looking little characters, with faces much like a bulldog? Perhaps you have watched some of them tacking about by means of the power they get from the recoil of their curious little water cannon, which is in truth a sort of yawning funnel, that serves the double purpose of breathing gills and swimming agency.

"No? Well, you have missed some mighty interesting individuals. Suppose you take the garden rake and a bucket and go down to-morrow afternoon. Rake out the first bunch of trash you note in the bottom. I dare say it will have several nymphs cradled in its meshes. Look

sharp; for their color is exactly that of the rubbish which shelters them. They have six grasshopper-like legs, and no wings, but really you do not need any further description; their faces name them. One caution: don't put the nymphs in your aquarium when you get home. They are every whit as ferocious as the ugliest bulldog that ever graced a kennel. Everything from small fish to mosquito larvæ disappears from before them, the size of prey, of course, depending upon the size to which the nymph itself has attained."

Such a conclave as there was when Tommy returned the next day with his find! And small wonder: for never had the children beheld such ridiculous looking individuals! Their heads were *just about all lower lip,* as Ruthie exclaimed, and with reason, for this peculiar feature covered the face like a mask from the eyes downward. Furthermore, as though this were not enough, the queer trap, as they soon discovered it to be, was hinged at the " chin," and folded backward along the breast between the bases of the fore legs. When offered a fly, the lip shot forward with lightning-like speed, revealing a formidable armament of teeth, hooks, and spines well adapted to holding any struggling creature, no matter how wildly it essayed to get free.

" There are other nymphs similar to these in the old pond," Uncle John explained when he

came in. "But they are not so plump; their habit of burrowing under the sediment along the bottom tends to flatten them out. Indeed often all that can be seen of this species is the tip end of their body reaching upward for breathing purposes. Yet other nymphs exist that are so widely different in form that their relationship would never be suspected but for their bulldog faces. These nymphs have worm-shaped bodies, with three flat gauzy gills shaped like so many elm leaves clustered at the posterior end.

"Nymphs are the larvæ of certain very interesting little winged creatures, but I am not going to disclose their identity. Feed your captives well on flies or any other creatures that come to hand which are smaller or weaker than themselves, and watch daily for developments. You will find them changing their suits whenever they get too small, and probably several such changes will be made before the grand transformation. The nymph does not pupate; when it gets good and ready it simply casts its old larval skin and unfolds its wings, shakes them dry and sets out on its self-appointed task of policing the air for flies, gnats and mosquitoes."

"Air policemen are they—*hmm,*" murmured Max. "Let's see: if we guess 'em, will you tell us, Uncle John?"

"No, he *won't,*" Tommy decided sharply.

"That would spoil half the fun of finding out for ourselves. We'll watch!"

And watch they did faithfully, until a day came when the largest, plumpest nymph climbed up the stem of the water plant which had been thrust into the big glass jug which formed their quarters, and remained so motionless in the bright sunshine that all felt the final hour of triumph had arrived. Uncle John had warned that the transition might take some time; so a guard was established, and all went about the duties of the morning until Grandmother, who had the eleven o'clock hour, set the bell pealing which meant, *the skin has begun to crack: come!*

How eager and excited they all were! "What will it be, do you s'pose?" Ruth whispered tensely to Grandfather, but he only shook his head, and bade her keep her eyes open.

And indeed there was every necessity for this if she was to witness the miracle. For the crack turned all suddenly into a broad split, and shortly there emerged an odd, damp, pointed creature, with a large head on a slim neck. Its legs were short and near the front of the thorax, and all curved forward so sharply that it was plain their purpose was not for walking, but for grasping and clinging to their prey. The eyes were very large, and the folded antennæ, when shaken out, proved to be small and short. Evidently the

glory of the creature was to be its wings, which were wrapped about it in sheeny folds. Two pairs presently emerged, of nearly equal size, with so many veins crisscrossing in every direction that their surface seemed to be cut up into tiny cells. Moist and weak and crumpled they were at first, but the hot sunshine soon remedied this, and when Uncle John slipped off the screen frame which covered the "nursery," the little creature rose and sailed gracefully away.

"Snake-feeder," ejaculated Max, following its course happily.

"Devil's darning needle," Grandfather affirmed, and added slyly: "If you don't watch out it will sew your ears fast to your head! Leastwise, that's what folks used to say when I was a boy."

"Daddy Thornton says its business is to feed and doctor snakes, especially water snakes," Tommy averred. "He terms it a snake doctor."

"They call it the flying adder, and the horse stinger over seas," said Uncle John, "both terms being indicative of former superstitions. The proper term is dragon-fly, and the little creature is in truth as harmless as it is beautiful.

"Dragon-flies come and go. None of them lives to a ripe old age, from twenty-five to forty-five days being the average limit. But new ones are continually hatching throughout the season,

and the cycle of growth is thus kept up apparently without a break in the ranks of the air police force. They are indefatigable in the pursuit of their duties, and dart hither and yon, altering their direction with the most surprising suddenness, and never by any chance failing to seize upon their prey. Possibly gnats and midges are seized with the jaws, but larger specimens are undoubtedly pinioned by means of the curious legs, which are so adeptly curved and turned for grasping. Always the victim is devoured during flight, and so rapidly is the whole performance executed that it is impossible to more than guess at the details. Flies form the bulk of the diet, but small butterflies and moths are frequently taken, and on occasion a wasp has been seen to disappear before the dragon-fly's lightning charge. Large dragon-flies are said to devour smaller ones, and indeed will even grasp voraciously at their own bodies when offered them. They have enormous and indeed apparently entirely unappeasable appetites. One authority affirms that he fed a certain large specimen forty house flies inside of two hours.

"Some two thousand species of dragon-flies are known, three hundred of these being found in America, but never all of them in any *one* locality. States differ in regard to the number. For example, something over one hundred may be

found in New York State, while but fifty specimens have been counted in California. Dragon-flies cannot stand an arid climate. Their favorite haunts are in the vicinity of ponds and small streams, but on bright sunny days they may venture far over the meadows in search of prey. Because of the striking beauty of their wings, which do not take on their color for several hours and sometimes even days after hatching, dragon-flies offer especial interest to collectors. Two distinct types of dragon-flies are recognized: the *Zygoptera,* whose wings in repose are held upright; and the *Anisoptera,* whose wings are held horizontal. To the former belong the pretty little slender-bodied species called the damsel-flies, whose wings show such brilliant spots of color. Besides the common blue damsel-flies, other familar kinds are the red-spotted, the black-winged, and the green-bodied damsels. It is in the *Zygoptera* clan that the greatest range of size is found, the smallest having abdomens only about half an inch in length, while the largest has an abdomen of about four inches. Usually both males and females are marked alike; the exception is that of the amber-wing dragon-fly, the males having wings of clear amber-yellow, while the females have plain wings splashed with irregular amber bands.

"Some of the dragon-fly females carry sharp

little egg-laying tools for the purpose of depositing their eggs in the tissue of plants. Others lash the water with their abdomen, thus allowing the eggs to be washed off. Certain species choose pond sites for their nursery, others prefer small streams, and still others like the swift running water. The dragon-fly nymphs are often called water tigers, because of their voraciousness. As a clan, the dragon-flies belong to the *Odonata,* or membranous-winged order. Their nearest of kin are the May-flies, white ants, old Madam Doodle-bug,[1] and the little lace-winged flies.

"Because of their habit of swarming and migrating in immense numbers, in times gone by, the dragon-fly was the subject of no little superstitious dread. The folk-lore of Europe and the Orient abounds with strange tales of these fierce-looking insects,—the Devil's own darning needles. According to the annals of Illinois, one day in August, 1881, the air for miles around was literally alive with dragon-flies, swirling from a foot above ground to as high as the eye could reach. They followed a southwesterly course, and were bound who could say whither, and with what evil portent? Naturalists are now satisfied that dragon-flies migrate only when forced to do so by the drying up of the ponds and streams where they have made their homes. To-day the

[1] Ant-lion.

number of dragon-flies is rapidly diminishing the world over, because of the drainage of their breeding places.

"The dragon-fly has proved, in the past, a very great friend to man. I wonder if any of you can guess how?"

"I wonder if you mean that he kills mosquitoes?" asked Tommy. "I have seen him chasing them many a time."

"Right. Countless millions of these little blood-suckers have been slaughtered by the vigilant policemen of the air—to our own comfort."

AN ARTFUL LITTLE DIVER

"I MET another one of the pond's distinguished citizens to-day," Tommy observed, as the family gathered for their usual half-hour in the twilight. "But I was at a loss what to name him: he was extremely energetic, swimming and diving in every direction, and sometimes leaping clear above the water to snatch his prey. He had prominent eyes, a stout beak, long feelers, an abdomen tapering to a tip, and his body was moderately stout. His suit was dark brown, and he was probably half an inch in length, all told. At first I thought him a spider, but he didn't classify, as his six legs proved him to be an insect."

"Good!" applauded Uncle John, softly. "I have high hopes of you, my lad. Nine out of ten people unquestioningly name these little pond creatures water spiders. The naturalists, however, have dubbed them the water striders, because of their seeming ability to stride here and there across the surface of the water on their remarkably agile long, slender legs. Their eggs are fastened to the under water stems of plants,

and the creatures hibernate in the mud in the bottom of the pond. They belong to the bug family, and though truly aquatic, they are structurally nearer akin to the land bugs than to the other water bugs.

"Though various American members of the *Lycosa* clan are fond of spinning their webs near the water and at times of running over the surface or diving beneath it, we really have no true water spiders in our country, albeit another insect, the water *mite,* is commonly mistaken for a small spider. But there is a water spider, a most interesting specimen, belonging to the *Lycosas,* known as the *Desia,* which lives under seas among the coral reefs in the Indian and Pacific oceans. Another spider, also one of the *Lycosas,* called the dome spider, is common along the waterways of Europe and Asia. This latter individual is the real prince of water spiders, or perhaps we should say princess, as it is the female that is most in evidence. She is truly a past master in the art of house building, weaving a veritable silken palace that is strictly water-proof. As she swims about on the surface, she looks like a big silver bubble. And the reason for this shows what an artful creature this little spider is: she is really encased in a ring of air bubbles formed by air entangling in the thick, fine hairs with which her coat is covered. The water presses round but

cannot get between the hairs, and thus the air is imprisoned, making a perfect little wrapper of compressed air for the spider's use when she goes below.

"But this is not all. If we could don a diver's suit, and go down to her under-water retreat with the spider, we should find that her den on the bottom of the stream is even more wonderful than she herself is. To begin with, her home is always built between two stones, which serve not only as the beams and rafters, but for firm anchorage as well. And, as you may well imagine, it often takes no little searching to find just the right location: for the spider is just as particular regarding shade, and view, and good water as we are when we go hunting building sites. It is not enough that two stones shall be found in close proximity to suit her needs. The water thereabouts must be fresh and pure and not too swift. Also there must be plenty of mosses and herbage to serve as a screening background for her little domicile. The ideal spot is two stones nearly of a size standing quite close together amid a clump of wide-branching seaweed.

"Having found such a spot, the spider attaches her thread to one of these rocks and starts her silk factory going full blast. As her silk is reeled out she winds it round and round her own body, yard upon yard, until at length she is in

the center of a deftly fashioned hut of silken thread. Then she makes fast her thread and goes outside to have a look at the house. What a quaint little dome-shaped affair it is! It looks very much like a miniature Eskimo hut. But there is no door in the side. Indeed, at first glance, there does not seem to be any door at all. But of course there is, else how could the spider herself have come out? If we could swim under the hut through the narrow channel between the stones, we should see that the door is placed in the floor; moreover, it stands open most invitingly. How many unwary minnows, water bugs, tiny crabs and other sea folk essay to pass that way to their undoing? Who shall say: for of course, *Madam Argyroneta* is an expert fisher, and it is in this clever manner that she essays to stock her larder.

"But there is another reason for having the door opening from the floor into the water: you know that air never sinks in water. And there must be a good supply of air in the dome at all times, for here the little *Argyroneta* babies are domiciled until they are able to care for themselves. Whenever the little mother comes down from the surface, she always brings a load of fresh air held securely in her hairy coat. Once inside the hut this life-giving oxygen is released: the roof of the dome prevents its escape, and, of

course, it cannot depart by way of the door, as the mother does. For the latter reason, the moment she comes out, *Madam Argyroneta* rises to the surface: she must have air to breathe.

"Once upon a time, a certain *Argyroneta* housewife had waited in vain for something to get entangled in the clever nets she had strung across her little fishing-pool; her larder was empty and her babies clamoring for food. Something *had* to be done, and at this juncture the voices of some little crab children were heard outside, close to the walls of the dome.

"'I do wonder what this soft, silken shape is?' one of them was saying. 'It is so fresh and dainty. What a lovely blanket it would make! I wish we could find a shell big enough to house it.'

"At once *Madam Argyroneta* was out through her lowly door and appearing bobbing and smiling, albeit a bit breathless, before the surprised and half-frightened young crabs. 'I heard you admiring the walls of my house, my dears,' she said. 'It is much lovelier inside. Won't you come in and look around, and see my babies? I have a score or more. I think, too, that I can offer you some delicious oyster crullers. I dare say you are hungry at this hour in the morning; most young sea folks are.'

"Altogether the offer was too kind to be re-

fused; certainly nowhere was there a pleasanter looking hostess. The young crabs followed her with alacrity, and they were soon inside the dome. But there, as they stopped to admire, a sudden shock of misgiving smote them. White and deliciously airy the place was, to be sure; but what was all that rubbish strewing the floor? Heavens! it was just like a charnel house. Bodies of caddis worms, young oysters, sea slugs, yes! and *crabs* lay in every direction. In alarm, the youngsters turned to flee. But their hostess quickly blocked their path, and oh! how curiously her big eyes flashed. Gone, too, were her pleasant smiles and graces. 'What little ninnies you are, to be sure!' she cried harshly, and with that she pounced upon them for all the world like a terrier suddenly loosed among a nest of bewildered and frightened young rats. Snatching the crabs up one at a time, she bit sharply and viciously into a vulnerable spot, and flung the limp victims hurriedly to one side. 'Aha! what a splendid catch!' she exulted. 'How quickly flattery fills an empty pot!'"

"*Hmm!* Spiders is spiders," adapted Alice softly, and swooped up Ruthie with a quick "Come into my parlor, honey," as she buried her face in the soft, dimpled neck and made as though to eat the eager, round-eyed little girl all up.

"True enough," Uncle John smiled, himself

going on to turn an old-time phrase to suit his needs. "Once a spider, always a spider, whether on sea or land. In winter the *Argyroneta* builds a snug warm nest in deep water where it hibernates until the season comes round for the pursuit of its legitimate business. Never was there a professional diver more devoted to his craft than is this creature, which wants air to breathe like all its kin on land, and yet chooses to build its home at the bottom of a pond or stream and even on the sea floor. It is a striking example of the adaptability existing in Nature everywhere. Having an appetite for water fare, this little animal, with so many land-like traits, proceeds to show that we are creatures of our environment only so long as we choose to remain such. Our destiny lies in our own hands; we can become whatever we most desire to be."

"That being true," averred Tommy stoutly, as one and all turned to their own pursuits, "just watch me become Mr. Thomas Lane Dayton, the eminent authority on all sorts of nature lore!"

THE BIRDS' WATCHMEN

"MERCIFUL goodness!" ejaculated Mabel, covering her ears with her hands. "Did you ever hear such an outcry in all your life? What do you suppose is the matter?"

Grandfather smiled his slow jovial smile that always dispelled irritation. "Well," he hazarded, "knowing the catbird as well as I do, I would say that he is merely springing his watchman's rattle. You know, legend relates that the catbird was once a sneaking gray cat that pilfered the birds' nests, eating both eggs and young, until in desperation they gathered in a great convention and petitioned the gods to help them. Straightway their enemy was changed into a bird and doomed to nest low in the trees with a watchful eye ever on the homes of his neighbors. His erstwhile call, with which he was wont to make the night melodious, alone was left to him, and this in due time he adapted to serve him admirably as a rattle. Of course, being a great jester, mocker and impersonator, the catbird often takes advantage of his position, but on the whole he attends remarkably well to the duties imposed on

him. Listen to his voice now rising loudly above the tumult out there. Is he not doing his best to restore peace and quiet?"

"He sounds just like Miss Berry used to when she banged her pointer down on the desk and yelled '*Order!*' at the top of her lungs," commented Alice, dryly.

"And I doubt not he succeeds about as she did," Tommy laughed. "If the truth must be told, I'm pretty sure he often starts the riot! I've seen him stop suddenly in the midst of a song—and he *can* sing, for sure!—and go drooping off with a comical hang-dog air that is laughable enough when one knows he is only putting on some stunt. Probably half of his ridiculous attitudes and poses are a part of his detective's disguise. Who knows what bird mysteries he may be unraveling while he acts the part of a clown?"

"There's a catbird's nest in the blackberry tangle down in Daddy Thornton's pasture," Mabel confided. "I saw it just the other day. It is thrown together helter-skelter, sticks and leaves, rags, bits of string, newspapers and what not, like any old scrap-basket. But it is softly lined, and probably the little birdies hatched from the pretty green eggs will be as happy as though cradled in the finest structure known to Birdland."

"I love the catbird," Auntie commented. "To my mind he is not so much a watchman as an actor. A veritable vaudeville clown he is, so full of jokes and tricks that a volume could not contain them all. On occasion, too, he excels as an opera singer. Like his interesting cousin, the mocking-bird, his song bag contains a varied recital of other birds' notes, with a few bars of his own thrown in to complete the measure. Mrs. Wright interprets his usual lay as '*Prut! Prut! Coquillicot! Really, really, coquillicot! Hey, coquillicot! Hey! Victory!*' But he is full of unexpected surprises; he may run on uninterruptedly for an hour, or close mysteriously after the first few notes. The early morning always seems to find him in the happiest moods; his catcall seems to be most in evidence during the nesting season. Both he and his little wife are nervous and highly strung, and it does not take much to rouse them to a fine scolding order."

"If you are bent on discovering the real bird watchmen," put in Uncle John, "observe the kingbirds. You know them, I think. They wear a grayish-slate dress coat and a dapper white silk vest. There is a concealed crest of orange-red on the crown, a black tail broadly tipped with white, black feet and bill. Mrs. Kingbird is similar to her mate, with the exception of the crown. They are very devoted to one another,

and both of them delight in policing the neighborhood for birds of prey, crows and blue jays. They hate these rascals for the cowardly, sneaking thieves that they mostly are, and Mr. Kingbird likes nothing better than to establish himself in some tall tree, or other high vantage point, from which he keeps a sharp lookout at all times, excepting when obliged to quit his post and take a turn at the nest while his mate gets a brief rest as she wings the air for her food.

"Nothing is more valuable in the poultry yard than a pair of kingbirds. They hate a hawk, and woe to one of these chance prowlers which ventures into their precinct! They are upon him instantly, alighting on his back and pecking him unmercifully about the head and neck, until he is glad to turn about and flee for his life. Kingbirds are often to be seen among the cattle in the pasture policing the backs of the cows for the miserable gadflies which cause them so much trouble. Ninety per cent of the kingbird's food is composed of meat,—beetles, grasshoppers, wasps, spiders and butterflies being highly relished. He has also been accused of a fondness for bees, and bee-keepers regard the bee-martin, as he is called, with a baleful eye. Good authorities, however, maintain that the bird eats nothing but drones. This being true, he is really of service in the apiary."

"There was a tremendous hue and cry in the garden one day last week," supplied Alice, "and on going to learn the reason I saw a pair of kingbirds pursuing a red-headed woodpecker across the yard at a great rate. I wondered what he had been up to, and later as I passed by the brown thrasher's nest in the rose hedge I saw that her brown-speckled egg was gone. I remembered then that she had been chief among the birds in the tumult, and I'm pretty well satisfied the redhead was the thief."

"Circumstantial evidence has convicted many an innocent bystander," warned Uncle John. "Maybe Mrs. Brown Thrasher jumped to a conclusion, just as you have done. The robber might have been a cat."

"Only the slyest and nimblest of cats could reach the nest," Alice returned, "and you know the redhead is not above pilfering on occasion. I was sorry, for I felt sure the brown thrashers would abandon their nest, and they had spent so much time and labor on it, building a deep, cosy structure and decorating it handsomely with frills and streamers of torn paper. But evidently they had faith in the valor of the kingbird watchmen; there are three eggs in the nest now, and Mrs. Brown Thrasher has been sitting for a week. Her husband is on constant guard, and once when the thieving redhead flew across the yard he let

out a screech which brought the kingbirds to his side in a hurry. But their services were not required, for the woodpecker stood not on the order of his going, and I don't believe he has ventured near since."

"Hmm," mused Uncle John, "that does sound bad for friend Redhead. But I can't help but like the merry drummers, and indeed egg-stealing is so infrequent among them that such doings are believed to be the work of some degenerate member rather than a family trait. The redheads wear the national colors, red, white, and blue so well that they are often called the flag birds, but alas for their reputation, sometimes their blue is so black that they have been accused of wearing the German colors."

"Doubtless it was such a one who robbed the brown thrashers," Tommy declared. "Where do the kingbirds nest? I've hunted high and low without success."

"The favorite site is an apple branch high up, but they will occupy almost any tree about the garden and lawn. Grasses, moss and weed stalks form the carefully made nest; the lining is of plant down and fine grasses. There are from four to six rosy white or creamy eggs, softly spotted with brown and lilac. The young king-birds are fretful, obstreperous little chaps who cry a great deal, doubtless deeming that

their mother should pay more attention to them and less to the general affairs of the neighborhood.

"Just as the catbirds and kingbirds are the bird policemen of the garden and orchard, so, too, the yellow-breasted chat keeps watch over the thickets of woodland and pasture. He is also a clown, and a fine ventriloquist in the bargain. He can do all sorts of stunts. Listen to what a poet bird-lover says of him:

"Aloft in sunny air he springs;
To his timid mate he calls;
With dangling legs and fluttering wings,
On the tangled smilax falls;
He mutters, he shrieks—
A hopeless cry;
You think that he seeks
In peace to die;
But pity him not; 'tis the ghostly chat,
An imp, if there is one, rest sure of that.
—Abbott.

"Burroughs tells us that he can bark like a puppy, quack like a duck, rattle like a kingfisher, squall like a fox, caw like a crow, or mew like a cat. But why he goes through all this rigmarole is an unsolved question. Perhaps he seeks to entertain his brooding mate; again it may be that his own excessive energy drives him to these stunts to keep himself from boredom as he patrols his usually quiet beat. In one of his principal

features, he suddenly starts aloft with a loud cry, then holding his wings stiffly above his back and letting his legs dangle brokenly, he sinks downward with a zigzag jerking motion, as though hauled back into the shrubbery by an invisible force. Perhaps he thinks thus to ward away his enemies! If he does, it is certainly mistaken energy; for the dullest observer can but be attracted by his queer antics. Let one come within a quarter of a mile of his precincts, and he sets up a worried protest, screaming vainly that his nest is somewhere in the copse, and that you mustn't look for it, much less touch it. Poor little ninny! His very lack of discretion is his undoing.

"Nor is he any wiser after nightfall. Like the mocking-bird and the rose-breasted grosbeak, he is fond of twittering away to himself in the moonlight. The yellow mocking-bird, some people call him, but he does not belong to the mocker family, which includes simply the mocking-bird, catbird, and brown thrasher. He is a warbler. The redstart, the ovenbird, and the summer yellowbird or wild canary are the best known of his interesting kindred, who are for the most part delightful bits of feather, smaller than the English sparrow, and garbed in coats of olive, blue, and black, deeply marked and splotched with white and shades of yellow. All of the family are fond of the deep

shade, and all bear the slender, finely-pointed bills of the true insect eaters.

"Our yellow-breasted guardian of the rough, berry-grown hillsides and dense, shrubby fields is identified by his chatter and the bright yellow of his vest, which gleams all the more brilliantly because of his olive-green back and white under-parts. His feet and bill are black, and his eye is nearly enclosed by a white ring, which adds no little to his clown's make-up. He measures about seven inches. Mrs. Chat's nest is not specially a work of art. But its bulk of grasses, weed stems and bark is softened by a cosy lining, and being placed near the ground in the most tangled part of the shrubbery, it would stay safely hidden, but for the crazy, over-anxious antics of her spouse."

A GREAT HUNTER

"FIDDLE-IDDLE-IDDLE!" The notes rang out sharp and clear and withal so challengingly, that the listener looked up from his book quickly. "Hello!" he said, "I'm Max Dayton. Who are you?"

The answer was prompt: "*Dick-fiddle-iddle-iddle.*"

"Ho, ho!" laughed the lad, "you are a jolly fellow for sure. Dick-fiddle-iddle-iddle! I'm certain I never heard of you before. But doubtless you are a distinguished member of Nature's orchestra; which do you play, first or second violin?"

"*Fiddle-iddle-iddle.*"

"Your pardon, I am sure," the lad laughed delightedly. "You are old-fashioned, I see. It's a fiddle you play. Well, go ahead and let's see what you can do."

But the little musician only reiterated his boast, and the lad chose to take exception to his failure to make good. "I don't believe you can fiddle at all," he cried scornfully. "And now I think of it, perhaps that is not what you meant me

to understand. Ho! Uncle John! Please come here. There's a bird asking you to fiddle-iddle-iddle. Evidently he has a fancy for listening to one of your concerts."

Uncle John came to the door, but instead of his violin he carried a book. Plainly he, too, was not in the humor for "fiddling." "Where is the gentleman?" he asked.

"Out in the bushes there somewhere," Max returned. "He seems to be loath to show himself, and I do not recognize his call. Dick-fiddle-iddle-iddle! Did you ever hear of such a fellow?"

"Often," smiled Uncle John, "and I'm sure you would recognize him, too, if he were to send in his card. It reads 'Mr. Dick-fiddle Chewink.'"

"What!" exclaimed Max, surprised. "The chewink! That industrious little chap that Grandfather calls the ground robin?"

"The same," Uncle John nodded confirmingly. "Some people name him the towhee. In the far south a white-eyed species is called the grasel. Four-and-twenty of them make a splendid pie."

"But, Uncle John, I've flushed the chewink countless times," argued the boy. "He always darts into the bushes with a whir of wings, and a flirt of his long tail, and I never heard him say anything but *kriink* or *towhee*. Sometimes when

he reaches a safe harbor he calls back tauntingly *towhick, towhick, towhee.* Tommy thinks he says: 'Can't catch, can't catch m-me!'"

"And I've no doubt that is exactly his meaning," Uncle John smiled. "For, as you have said, that is his note of defiance. His call note is a happy little cry of *towhee, towhee,* which leads to his name of towhee bunting. His love song is the little trill you have just heard, '*Fiddle-iddle-iddle, Dick-fiddle-iddle-iddle!*'" Uncle John imitated the notes so cleverly, that at once there was an angry little query from the shrubbery: "*Towhick? Towhee?*" Evidently Mr. Dick-Fiddle feared that a rival had arrived in his precincts. But Uncle John forbore to tease him. "Go on back to your lady love, Dick," he advised. "I'm extra busy."

"But, Uncle John," detained Max, "wait a minute. How shall I make the acquaintance of Mrs. Chewink? I know her spouse well enough: he looks much like our friend robin redbreast. But he is smaller and darker in color than the robin, with black in his coat instead of tawny brown."

"Mrs. Chewink is very like her mate," informed Uncle John, "save that she is a bit smaller and less brightly colored. She builds her nest in a hollow on the ground, and then foolishly covers it with twigs and leaves to the peril

of the dusty white speckled eggs and the helpless little fledgelings which are often crushed beneath the heel of the unwitting passer-by.

"The chewinks belong to the Finch family, and they have many finch-like traits. For example, watch them do their leaf-scratching: One jump into the air, a quick motion forward, and how the leaves do fly! You know perhaps that the finches are the Smiths of Birddom. The family is so exceedingly large that it comprises about one-seventh of the bird world. In truth, one is quite safe in naming a bird a finch if it doesn't fit readily into any other family. The sparrows all belong to the finch tribe, so do the redpolls, the crossbills, our dear little grosbeak neighbors, and the buntings, juncos, and snowflakes numbered among our winter visitors. For sociableness and good cheer the chewinks rival their nearest of kin the goldfinch and that wonderful blue 'air-flower' the indigo bunting, though they have not the musical talent of these little friends, nor their skill in architecture either, for that matter. Mrs. Goldfinch's nest you already know. It is a marvel of weaver's art, being a deeply hollowed cup of vegetable down and plant fiber, lined plentifully with soft thistle-down, and placed about twenty feet from the ground in the crotch of a fruit or shade tree. The indigo's nest is built in the bushes, or perhaps hung from a

weed stalk. Grass, leaves, downy seeds and fine roots, with a lining of fine grass and hair, make up its comfortable depths. Another cousin of the chewink is the purple finch. He is a veritable little music-box, and is as well known to the boys and girls of the Middle and New England states as the robin is to you. Indeed Mrs. Purple Finch has such confidence in mankind that one may almost touch her while she is brooding. She has doubtless never heard of caged finches, or if she has, their common name of purple linnet deceives her.

"The chewinks are exceedingly industrious, and must be numbered among our very best insect hunters. They come early enough to destroy the sleepers in the rubbish piles, and here is where the chewinks get in their best service to mankind. They destroy these nuisances before they have a chance to propagate. Chief among the pests so taken are the beetle larvæ, especially the white grub of the May-beetles. But the chewinks are not by any means partial to beetles. As the season advances, you will find them hunting moths, hairy caterpillars, cabbage worms, grasshoppers, potato bugs, and even cockroaches. There is practically no limit to their appetite, and a half dozen chewink families on the premises will save the farmer and orchardist many dollars throughout the growing season."

"I shall go and tell Tommy about 'em this minute," averred Max, as his uncle turned away. "We boys are never half careful where we step! I came up through the shrubbery pell-mell not half an hour ago. I do hope I didn't crash into Mrs. Dick-Fiddle's quarters!"

THE FIRST PAPER-MAKERS

"HEAR! Hear, folks!" Alice proclaimed, rapping smartly on the table, as one who must have instant attention. "This is an S. O. S. call. Miss King has given me the hardest subject for a composition: 'The First Paper-Makers,' and I can't find a thing about them in the encyclopedia, though there is oodles about paper. Fancy, if you can, what it would mean to do without paper! I could write a good theme on that, but—*who* ever made the first paper anyway?"

"The Chinese, if you are referring to the product of man," Auntie replied, "but I imagine Miss King had in mind the real founders of the art—the hornets."

"To be sure she did," Tommy spoke up quickly. "I was telling her about our hunt for Nature's craftsmen just the other day, and she said she would love to help. But the hornets the first paper-makers! Say! I know something about their work. Why haven't we thought of them before?"

"Principally because we have not put on our thinking caps, I fancy," Miss Merryhew smiled.

"Then, too, we have been pretty much occupied with the little craftsmen neighbors that seemed to come naturally to hand."

"I should *say* so," chimed Alice, "and, though I want to know about hornets, I would just as soon we didn't attempt any intimacies with them. They are much too nervous and irritable to suit my fancy."

"Same here," agreed Max with great promptness, and everybody smiled, as the lad even then had one eye swollen half shut from the effects of a bee sting.

"The hornets do hold the original patent on paper," Uncle John conceded, as they turned to him. "Authorities all agree that man got his first ideas in paper-making from them. Indeed, the industry as we know it to-day is only about seventy-five or one hundred years old; while these little people of the great outdoors have been living in paper houses of their own manufacture since the beginning of time. Their young have been wrapped in the softest of paper blankets and nestled in the most perfect paper cradles, and, in short, paper of some kind and description has answered their every household need. One variety of their paper compares very favorably with the blotting paper made by man; their housebuilding paper is water-proof, and yet another kind has all the properties of cardboard.

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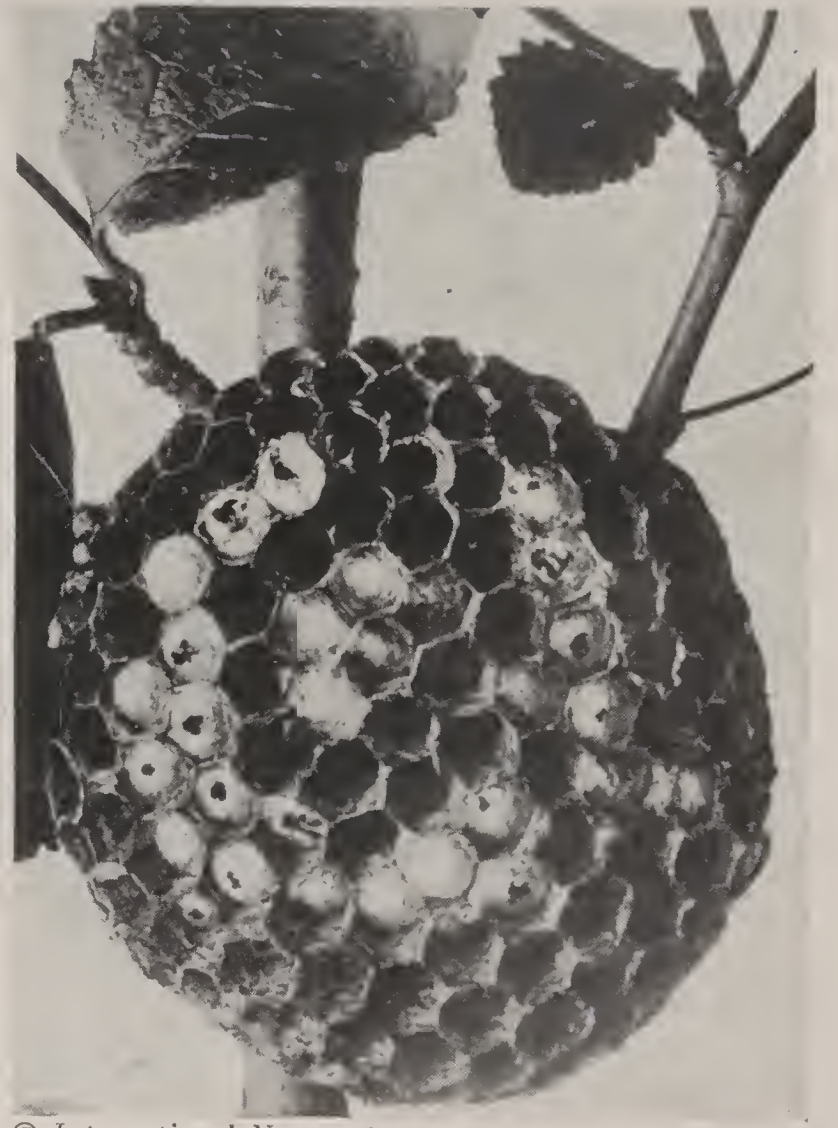
HORNET'S NEST ATTACHED TO A TWIG



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INTERIOR OF WASP'S NEST

And this notwithstanding the fact that the little workers have absolutely no complicated machinery of any kind at their command—a feat which seems the more remarkable after visiting a large paper factory, and viewing the immense vats, huge rollers, and heavy complicated machines of various sorts which man finds necessary in the perfection of the paper art.

"Another thing: man makes paper of old rags, wood pulp, water, and a combination of chemicals for bleaching and whitening. The hornets use nothing but wood. They prefer old wood well on the verge of decay,—an old log, a fence post, a window ledge where the paint has pealed and cracked; but if this is not to be had, they will work on the bark of young trees, and in consequence often do considerable damage in a growing woodland. Likewise, too, all kinds of vegetable refuse, moldering leaves, plant stalks and the like serve the paper wasps in nest-building arrangements.

"The bald-faced hornet is the best known of the little paper-makers, but as a matter of fact she is not a hornet at all. She belongs to the tribe of social wasps, and shares her trade in common with the other members of the family. Naturally they do not all fashion paper alike, but all of it is very strong and durable, and a wasp nest will last six or eight years. Of course, there

is also a wide difference in architecture. Some wasps build pear-shaped homes; others are round, and still others build in spiral form. In South America is a paper wasp which builds great structures fully three feet across, and containing thousands of little cells, each of which serves several times each season as the cradle of a baby wasp.

"Wasps, like bees, live in colonies which consist of the queen, drones, and workers, but no matter how strong their numbers they are creatures of one season only. The young queens, which are hatched late in the fall, leave the nest as winter approaches in company with the drones for a brief marriage flight. The first frost catches the shiftless drones, but the young queens, heavy with eggs, creep into some warm shelter and sleep the season through. Then, with the first hint of warm spring days, they come forth and each one chooses a nesting site and founds a new colony of her own.

"I once watched a young Queen Baldface at this task, and a more interested, industrious little individual than she I never expect to see. The location was the sturdy arm of an old oak which stretched behind the tool shed. The material came from the decaying timbers of the shed itself, and, notwithstanding that there was but one pair of tiny jaws on the job, matters progressed

with amazing swiftness. All day long and all night, too, I am sure, the work went steadfastly on, the little worker tearing off tiny splinters from the old rough-hewn timbers, chewing and moistening them with saliva and rolling them into a ball. When the ball was as large as could be carried, off she went to her workshop—a big leaf close to the site. Here the ball was spit out, thoroughly kneaded and spread in the sun to dry. But it was by no means finished. Just as the paper pulp in our factories is reduced to consistency by mixing and beating, so, too, is the little hornet's product prepared. And I wouldn't undertake to say how many times each little pellet was turned, kneaded, chewed, and torn and spread to sun again. Some authorities claim eight or nine processes for each tiny bit of paper; at any rate the business went on over and over until the keen eye of the little worker was satisfied with the result. Then, as a finishing operation, the paper was sized or glazed. And how do you suppose this difficult work was accomplished? Simply by licking every portion of the surface. When dry, the coating of saliva was firm and hard and moisture proof.

"After enough material had been collected to warrant the beginning of actual building operations, the queen proceeded to lay the foundation, or perhaps we had better say the ridgepole; for

the hornet is the queerest of all known carpenters. She builds her roof first, and follows with the attic, upper and lower stories, and last of all the basement! First Queen Baldface applied a liberal coat of glue in the shape of her ever useful saliva. Then came a paper cable laid bit by bit, about half an inch in length and as thick as a good stout darning needle. Upon this was hung a ball-shaped house of paper, about the size of a hen's egg, with a small hole at the bottom to serve as a door. Then, without pause or rest, the furnishing was begun. Of course, as the door was too small and the interior darker than a pocket, I could not follow matters there very well. But I knew from the examination of old nests, that she packed the place as full of cradles as they could stand, and in each one she put a tiny egg.

"It was surprising, too, how soon the little family appeared. Short, indeed, was the brief rest allotted the queen mother. But doubtless she was glad to have it so. The season would be all too brief to build the house of her dreams, and leave behind a satisfactory contribution to the hornet race. How she worked those first few days, gathering food for the ten or a dozen hungry mouths! And her temper was peppery to a degree! I ventured an offering of fruit juice in an old can, with the idea of relieving her tiresome trips to the strawberry field and raspberry

patch. But I lost the use of both eyes for a couple of days for my pains. After that you may be sure I pitied her arduous labors no longer. And she really didn't need my assistance; for the babies were grown up in short order, ready to take their places as willing workers in enlarging their home and building new cradles, that more workmen might be supplied.

"There was no more earnest labor on the farm that season than went on down there behind the old shed. Such rasping and splintering of wood and plant fibers; such chewing, kneading, and pommeling; such turning, drying and fitting. In place of the humble little paper cot of a dozen cradles there soon rose a stately edifice, fully as large as a huge grapefruit, with countless cradles for young Baldfaces. But not yet was the Queen's ambition satisfied. Indeed, it was plain that only the very best that each one could do, working might and main, would be acceptable. Thus, daily additions were made to their paper palace, and the continuous and ever increasing clamors for fly meat and fruit juices kept every one on the wing, notwithstanding that young recruits were constantly reaching maturity and joining the working hordes. With the advent of the young queens and drones, matters reached the pinnacle. I sometimes wondered if the frantically busy little folks ever slept. Then af-

fairs of my own reached a desperate pass, and when I again found time to observe the Baldfaces their erstwhile busy factory hung empty and forlorn. Their labors were over, their goal achieved, and they themselves had gone the way of all insect paper-makers. What marvels of patience, fortitude, and untiring industry they had been! Before their eyes beckoned a certain purpose to be achieved and to this end all their forces had been bent. Nor was anything short of death sufficient to turn them aside. What a homily for us all in their brief history!

"Indeed, taken by and large, there are no more interesting craftsmen than the wasp clans. The force numbers some nine hundred species. Nor are they by any means all paper-makers. Only the members of the social tribes, that is those wasps which live in colonies, follow this interesting occupation. The solitary specimens include nearly all of the principal trades. Some are miners, delving deep into the earth; others are carpenters, cutting out their homes in solid wood; still others are masons and potters, working in mud and clay. Whatever their calling, each and all of them rival in industry the busiest little busy bee that ever bustled about. You will find it most interesting to seek them out and learn their habits. Moreover, so long as you do not attempt to interfere in their affairs, they will not resent

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MASON WASP AT HER NEST

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THE "JUG BUILDER"

your presence. Wasps and hornets never start a fight unprovoked, but they *are* suspicious, there's no doubt of that. And goodness knows they have had reason to be!"

AN INSECT CARPENTER

"I HAVE had my eyes open for wasps and hornets ever since we talked about them the other day," announced Tommy, one evening. "But I haven't had any luck until this afternoon when I was crossing the big woods. I had been loitering along watching a flicker courtship, and say! that's another story, but I'll tell it first. The flicker has been called the polite bird, you know, and this love-struck specimen was certainly a prince. How he did bow and scrape, almost twisting his neck out of the socket in his efforts to show what a beautiful red crescent he had on the nape of it! Then he spread his wings and his tail and flirted about to show their lovely sheen and extreme length. 'Just see what a large handsome fellow I am!' he seemed to say. And he pranced about, bridling and stepping forward, backward and sidewise, and swelled out his pretty, black, crescent-marked breast. All this time, too, he kept up a dreamy coaxing note, which sounded like the soft swishing of a willow wand. He certainly did produce a fine effect; but every once in a while the ninny spoiled the

whole thing by letting out a silly, nervous laugh that made me long to shake him.

"By and by, however, matters were evidently settled, and Mr. Flicker flew over to a big hollow stump near by. I hardly think he meant to indicate that this might do for a nesting site. Flickers usually go high.—High-hole, you know, is one of their many names.—More than likely he thought to find an ant or some such dainty to offer to his sweetheart. And I think he was just as astonished as I was when the biggest hornet that ever buzzed flew from the ruins and gave him most plainly to understand that trespassers were not desired. With a loud yarup, he turned tail, showing the white feather in real earnest, as his golden wings bore him away through the grove.

"I remained perfectly motionless, and Mrs. Hornet did not so much as give me a glance. Two carpenters would be one too many, she evidently thought, when she objected to the woodpecker's intrusion; for I soon found that she was herself no mean workman, and had undertaken to construct a home there in the stump. How savagely she seemed to bite and tear at the decaying wood! I was astonished at the size of the splinters she managed to break off, but I've been looking up the subject a little since I came home, and I find that in proportion to her size

the hornet has the strongest jaws of any living creature.

"She had only just begun on the job, but so steadily and to such purpose did she work that she soon had an opening that seemed to suit her needs. As she chiseled and rasped, she had taken the precaution to chew each piece to smithereens before she dropped it. I couldn't understand the purpose of this; so I determined to wait and see. By the time her doorway was completed, she had quite a pile of this saliva-mixed pulp. But to all intents and purposes she had forgotten it; for now she plunged into a perfect frenzy of house-cleaning, popping in and out every now and then just as you girls do to shake dust-mop and duster. You might indeed have gleaned a few pointers from her; for she seemed especially particular about her own person, stopping frequently to set her dress right and wipe her hands and face. Just because she was cleaning house was no reason for allowing herself to get all messed up and untidy.

"I thought she would never get done, but I knew better than to make any offer of assistance, even though I suspected that the careful sweeping and overhauling of the walls was a job altogether too severe for one small housekeeper. Nor did she seem quite content with just getting the walls clean, but went on rasping and ridging, until suddenly I understood quite well what she

was about. Her methods were those of the dentist who roughens the inside of a tooth to make the filling stick. The carefully prepared pulp was intended for cradles and partitions, and she knew very well that there would be small chance of making it stick to a smooth surface.

"How I longed to peep inside when she actually did get at the furnishings! But instead I came home and consulted Uncle John. He says the hornet is a mason as well as a carpenter. Once her walls are ready, she carefully plasters them with her wood pulp mixture, which is thoroughly water-proof. Then the cradles are built in, following the usual hexagon, or six-sided pattern of Beedom. Always the small cells are arranged tier on tier, with the mouths either opening downward or sideways. A person standing beneath the cells and looking upward could see directly into the cradles. This is extremely handy for the nurses, but it means, of course, that the cradles are always turned upside down!"

"Goodness me!" ejaculated Alice. "How do the babies stay in?"

"Just what I queried," laughed Tommy. "But the little hornet mother is quite equal to the problem. In the first place, her eggs are glued fast; then, when the little grub hatches, it clings to the shell by its tail, and cranes its neck out to be fed. The mother is nurse only until she raises

her first brood; afterwards matters go forward just as in a bee colony. And how hungry the baby hornets are! However, they are easily appeased: for they will eat anything and everything,—sweets, fruit, vegetables, and meat. Apropos of the last article, hornets are tireless in their pursuit of the common house fly, being one of his most inveterate enemies. They are fond of countless other insects, too. Indeed, so keen are they for a meat relish, that they are often called the insects of prey, just as the lion and tiger are called beasts of prey, and the hawk and the eagle birds of prey.

"To return to the little hornet grub: As it grows stronger, it wriggles and tumbles about, as babies will, and sometimes one forgets its tail-hold and tumbles out on the ground. Like Humpty-dumpty, all the king's horses and all the king's men cannot make it whole again! It is a job for the undertakers of the tribe, and it is quickly interred in the sawdust left at the junk pile. Barring accidents, however, the youngsters thrive lustily, and presently arrive at the happy state of the boy at the picnic, they can chew but they can no longer swallow, and so they turn their heads and refuse further offers of food.

"Shortly, then, they begin to grow sleepy and indolent. However, they must make themselves safe before they dare to shut an eye, and perforce

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HORNET ATTACKING A HONEY-BEE

they begin to spin fine threads of silk, winding themselves each in a little silken mummy case, which they stick fast to the walls of their cell. Now they can sleep securely, and while they are thus occupied Nature takes a hand and transforms them into full-grown hornets. They wake eager to try their strong jaws, and begin at once eating their way out through their silken wrappings. In no time almost they have joined the working forces, willing to do all in their power to further the strength of the colony.

"Uncle John is so enthusiastic regarding the industry and fidelity of the hornet tribes generally, that I mean to keep an eye on my carpenter clan. Perhaps I can induce some of them to neighbor with us next year. Uncle John maintains that, because of their many admirable qualities and the good work they do in destroying flies, it is unfortunate that man has recorded them in his black books. However that may be, I figure a large part of the fault lies with the hornets. They are so pesky suspicious! If I don't get stung for my pains, I'll be surprised."

"You mean," Max retorted sagely, "you will have pains a-plenty, if you *do* get stung. You would better go slow. Grandfather says he has known a half dozen of their poisonous stings to put a man in the hospital."

SOME FAMOUS NERVE SPECIALISTS

"WHAT would you think of a band of insects so skilful in administering anesthetics as to turn the most famed specialist green with envy?" Uncle John queried, as he and the children were setting forth for a specially conducted tour, on one of their always delightful half-holidays. "Keep your eyes open for a slender, slim-waisted shape, with a tapering abdomen held to the body by a thread, and decked out in a uniform of black, with red belts and bands, and gay yellow wings."

"Wasps again, Uncle John!" cried Alice. "Is there to be no end to the marvelous performances of these little people? What a book could be written about them!"

"Perhaps I shall attempt it, some day," her uncle laughed; "certainly it would make a most interesting subject, and an exceedingly large book as well, if one came anywhere near doing justice to them. The particular clan I wish to introduce to-day is known as the digger wasps. There are some twelve families in the group, and their homes are cradle-like burrows in the ground, well-stocked with a collection of beetles, cater-

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HAIRY WASP (DIGGER) WITH ITS BEE VICTIMS

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WASP ENLARGED SHOWING PROFILE

pillars, crickets, or what not, according to the particular taste of the species. The odd part about this stock of provisions is that the game supplied is not dead, but stung into insensibility, and so is kept wholesome and fresh until the little wasp grubs are hatched and ready to feed upon it. This is where the skill of the nerve specialist comes into play. Each little expert knows by instinct just where to plunge her hypodermic needle in order to strike the nerve centers and render the body inert and motionless without killing it. Both wise and merciful is this method of slaughter. And indeed it is the only solution to the digger householder's problem; any game that was killed outright and buried for the use of the offspring would decay and perish utterly before the little ones were in condition to use it. Besides their wisdom in this instance is to be considered their ingenuity in taking their prey, the skill with which their burrows are hidden, the individuality of the different tribes, and their cleverness in using improvised tools. But wait! you shall see and judge for yourselves.

"I had the good luck to run on to the burrow of a hairy sand wasp yesterday. Of course, as you will presently see, I should never have located it, had I not chanced upon Mrs. Hairy just as she was in the act of sealing up the place, and I set a mark of my own for future reference.

For it would be as easy to find a needle in a haystack as it would to spot the lowly door again unaided! Her tunnel is a well, about three inches in depth, sunk straight down into the bank along the creek, where there is a sufficient mixture of clay and sand to make drilling easy. . . . Ah! Go carefully. This is better fortune than I really expected."

And it was providential surely! For as they rounded the bend, behold! a large wasp rose from her labors and sailed away. They had come straight upon Mrs. Hairy at work in the excavation of another cell, and it needed but a moment for them to drop carefully down within range.

Finding everything quiet, the little driller soon returned to her task, and with her jaws for a pick, and her sturdy feet for both rake and shovel, how the dirt did fly! Soon she was quite lost to sight, but there was no abatement in her zeal, and presently as they waited in almost absolute stillness, there arose from the depths of the well a curious faint humming sound—the noise made by her little drill as she ground around some obstacle. "A bit of stone likely," Uncle John explained, and shortly the truth of this supposition was proved, when Mrs. Hairy appeared at the mouth of the excavation and tossed out a bit of quartz.

From time to time thereafter other bits were

brought up, and all went into a little heap beside the opening. Then, at the end of an hour, Mrs. Hairy came out, and began a careful cleaning of her person. Evidently the burrow was done.

"Will she be off now after meat?" Max murmured, excitedly.

"Wait!" motioned Uncle John. And almost as he spoke, the wasp went over to the rubbish heap and began a painstaking sorting of the pebbles. What was she after? The query was answered almost immediately, for Mrs. Hairy rose with a bit of stone, which she carried to her well, fitting it in the opening like a slab. Moreover, it was seen that she must have a very keen eye; for the tiny barricade fitted as though exactly made for that particular purpose.

"Eureka!" whispered Alice softly. And with one accord they all rose quietly, ready to follow wherever the quest for game should lead them.

This was not far. After a few well-directed kicks which sent the remainder of the rubbish heap scattering to the four winds, the wasp began to run here and there in the shrubbery, tapping the earth with her bow-like antennæ, and then pausing to listen intently.

"She is on the trail of what she considers the most delectable morsel known to the insect world —a species of caterpillar called the gray worm,"

Uncle John explained, "and wherever she stops and begins to dig there is always a worm. She doesn't always get him though; the ground may be too hard, or the worm too deep for her efforts. But it is always there, and with a little expert help may be brought to light. I have proved this time and again. How does the wasp know of the worm's presence? Probably the earth above its quarters gives back a hollow sound to her taps. At any rate, she is never deceived. . . . Now, watch!"

Fast and furious the wasp began to dig, and the soil was so loose that her efforts were soon rewarded. There was a sudden quick nab of her curved pincers, and out came the worm, rolling, twisting and resisting with every trick known to the caterpillar clan. Excitement was tense among the watchers, but Mrs. Hairy seemed calm enough. She just held on grimly to her find, and gave every appearance of giving the fat, cumbersome fellow time to tire himself out. Perhaps she only waited for him to expose a vulnerable part, for presently as the worm uncurled, she made a swift lunge, darting her lance into the joint between the first ring and the head. The worm wilted instantly, and then the witnesses saw a curious thing. The wasp, which had seemed entirely mistress of the affair, fell in a series of convulsions.

"Oh, poor thing!" Alice wailed sorrowfully, "the wretch must have poisoned her some way. Can't we do anything to help?"

"Wait!" cautioned Uncle John, quickly. And, almost ere the words left his lips, the wasp sprang to her feet, and with a quick shrug became cool and collected, entirely ready for the matter in hand. As she advanced upon the worm, Uncle John stated calmly: "Merely an hysterical fit of joy. She always has them to celebrate a victory!"

"Shades of Columbus!" ejaculated Tommy, wide-eyed, and an appreciative murmur followed the little gasp of wonder with which the information had been received.

Then all eyes were riveted upon the small butcher. Beginning at the joint below her first attack, she proceeded methodically down the length of the worm, jabbing in her lance at each joint, with never a hint of resistance from the victim. It is probable that he was quite insensible after the first thrust. In any event, as Max observed, they couldn't feel very sorry for him. Wasn't it just such creatures as he that stole into their gardens at night, cutting off their choicest flowers and vegetables, apparently for the very love of the mischief? Tit for tat; he deserved his fate.

Perhaps the wasp thought so, too; at any rate,

she was disposed to give him all in her power. And so, not satisfied with her lance work, perhaps fearing that the anesthetic administered would not prove sufficient, she seized the creature's head and began squeezing and pommeling it with her strong jaws. But she worked with care, pausing every now and then to note the effect. It was desirable to subdue the brain, but it wouldn't do to go too far. Death would result, and the worm thus be unfitted for her purposes.

At last the wasp seemed satisfied with her surgeon's skill. Desisting in her efforts, she grasped her victim by the cuff of his neck and began hauling him toward her burrow. This was no easy task. Though limp and resistless, the creature was awkward and ungainly, catching on every obstruction, and proving exceedingly hard to manage. At length the immediate neighborhood was reached, and now a new problem presented itself, which Max was quick to voice:

"How is she going to know which one of the many pebbles lying about covers her door? I couldn't tell to save my life!"

"Search me!" Uncle John returned, using the boys' slang. "But she knows all right."

This was plainly apparent. Without an instant's hesitation, Mrs. Hairy walked straight up to a "stone," and rolled it to one side. Then,

leaving her burden before the door, she quickly went below.

"A tour of inspection," explained Uncle John. "There is some mark of the fleece about that door readily understood by the wasp nations. There are hosts of brigand wasps about; any one of them may have entered while Mrs. Hairy was absent, and she goes down to make sure all is well."

Evidently it was; for in a twinkling the wasp was back, and quickly grasping her plunder she dragged it down out of sight.

"Now all depends on Mrs. Hairy's records," informed Uncle John. "That worm is a sizable fellow, large enough to nourish a small wasp to maturity. If the mother has stocked enough male cells, she will be back in an instant and close up the place. In the event that provisions are desired for a female, she will have to go on the hunt again. The females are much larger and stronger than the males, you know, and require considerable more nourishment."

There was an eager wait, then to the delight of all Mrs. Hairy appeared, and after quietly rolling the stone into place, began to kick pebbles and loose dirt about, apparently doing all in her power to obliterate the presence of a door.

"Another job done," commented Max, with a little murmur of satisfaction. "Likely now she

will go on a hunt on her own hook for the balance of the day."

But he did not know Mrs. Hairy. The season was nearing its close. It was her task to stock as many burrows as possible before Jack Frost's advent, and so with scarcely a moment spent in calculation, she moved down the bank a little farther and began the measurements for a new excavation.

"The best of luck to you, my friend," saluted Tommy. "I see you are like a host of other women kind; you don't know when to quit!"

And he followed the others up into the cornfield to look for another insect nerve specialist, which was also a tireless hunter.

"This little enthusiast," he informed, "is a hunter whose services are not half appreciated by the farmers. She goes gunning for the plump mischievous offspring of the May-beetle, the tiny rascals which take such pleasure in eating the tender roots of corn and other growing plants. These fellows are to be found carefully hidden from sight in their underground tunnels and galleries, and Mrs. Tiphia seems to know instinctively where they are placed. She runs along on the ground, tapping and listening, and presently begins to dig at a great rate."

"See!" Tommy pointed. "Here is a black waspish creature digging for dear life! Reminds

me of a dog trying to rout a rabbit from its burrow. I suppose it is a Tiphia?"

It was indeed, and matters had reached such a desperate pass that the hunter never even realized that she had an audience. Fast and furious flew the dirt as she sought to enlarge the opening she had made sufficiently to reach in and nab her victim from above. No sooner had she essayed this, however, than the worm promptly uncurled and turned over. Plainly its object was to keep its back hidden; for the wasp stayed her lance and began to dig again from the other side. Two or three times the worm flopped and turned, and the foiled wasp was forced to renew her efforts. But in the end she tired out her fat, short-winded antagonist, and at a moment when it was slow in turning, her sharp hypodermic needle was jammed viciously into the nerve centers behind the head. Instantly the worm collapsed, lying limp and senseless, entirely at the mercy of its relentless enemy.

But the Tiphia was not as vindictive as Mrs. Hairy. "She has no cause to be," Uncle John pointed out. "Here is an underground nursery all ready prepared, and food quite sufficient for her own little grub."

She simply smeared one of the white worm's fat grooves with a coat of stiff mucilage, and deposited an egg upon it. Then she sealed up the

chamber and made all safe and snug before rushing away to work her maneuvers all over again.

"In due time," explained Uncle John, "the drugged worm will come to life, and finding his enemy gone, will go on feeding contentedly. Safe and secure and all unsuspected the little egg rests in the warm cosy groove for a week or more. Then the little Tiphia grub hatches out and begins to suck its host's fat. Day by day it waxes stronger, and finally it eats through into a vital part and the beetle grub dies, but not until the young Tiphia is quite able to devour the carcass before it spoils. Then, finding no other food that it cares for in the dark subterranean passage, it promptly winds itself in a silken coverlet and goes to sleep. As it slumbers, Nature takes a hand, and by and by it wakes a full-grown Tiphia, longing eagerly for the bright sunshine and the life above, which some unseen Power whispers about. It takes but a few moments to work up through the earth, and find that all the world is full of swarming creatures of its own kind. Very shortly a mate is found; there is a gay, brief honeymoon, and then the males disappear, and the females settle down to a mad struggle with beetle grubs, as they hurry about in the eager business of their life mission. Just how large a debt the world in general owes to Mrs. Tiphia and her cousin Mrs. Hairy it would be hard to

estimate, but it is safe to say that these two wasp clans save thousands of dollars' worth of crops every year, and this for the most part all unguessed and unknown."

"I should say so," chimed Tommy quickly. "Why, I've never heard a single farmer mention them! I shall take Tiphias for my subject next composition day. And in the meantime I'm going to find out just what the band is doing in our neighborhood."

"Well and good," commended Uncle John briefly; "now let us go down to Daddy Thornton's pasture. There's a special exhibit there."

This proved to be more wasps, of course, a colony of yellow-winged diggers to the number of ten or a dozen, scratching in the sand like so many old hens, each one humming a glad little song which blended nicely in the general chorus.

"They seem care-free enough, do they not?" smiled Uncle John, "and yet really there are no more industrious little people around. Their motto is, 'Everything in its own good time.' They believe firmly in the old saw 'Play while you play, and work while you work.' Next month they will suddenly galvanize into action and crowd into the thirty brief days of September the labors which usually occupy the other members of the wasp clan for two months or more. Each female digs and victuals at least

ten burrows, and as you may well imagine, every moment must be made to count, for September weather cannot be relied upon; often there are cold, damp and rainy days when excavating is entirely out of the question.

"All told, no wasp is busier than Mrs. Yellow-wings, nor is there one that can vie with her skill on the hunt. Her prey is the staunch and powerful cricket, whose dreadful jaws are capable of tearing out the wasp's vitals in short order, if they can get at her. Its legs, too, are murderous clubs, fitted with a double row of cruel spikes, and it is most skillful in using them, now in making nimble, evading leaps, and again in administering wicked kicks. Yet the slender little wasp always prevails. Moreover, the cricket knows that she will,—what were those lines you were quoting yesterday, Max?

> "If you think you are beaten, you are,
> If you think you dare not, you don't.
> If you'd like to win, but think you can't
> It's almost a 'cinch' that you won't.

"Well, that's just the way it is with the cricket: notwithstanding its powerful strength, as soon as a wasp appears on the scene it takes to its heels in a headlong cowardly rush, and the little wasp, entirely sure of herself, pursues relentlessly. At the last moment, the cricket re-

sists. There is a tremendous amount of tumbling, rolling, and dust raising, but once the wasp has nabbed her victim, she never lets go, and by and by she manages to sink her sharp little hypodermic needle into the cricket's neck. It wilts at once, and there follows a neat bit of surgery. Into the stout neck, then into the abdomen the numbing lancet is thrust, and at length the cricket, quite paralyzed and helpless for all time, is borne away to Madam Yellow-wings' nursery. Nor is this last an easy feat! The cricket is a bulky burden, but by gripping with tooth and nail the victor manages to fly off in good order, albeit she must often make several rests before her lowly door is reached."

"In short," murmured Alice, "to complete the parable:

"Think big, and your deeds will grow;
Think small and you'll fall behind.
Think that you can and you will;
It's all in the state of mind."

"Exactly," agreed Uncle John. "It's a truism we see worked out all about us every day. By the way, I was reading a magazine article yesterday, and the substance was that there is a rude awakening coming to a good many of us. We will have to stop blaming circumstances and the other fellow for our failures. Take our

"Success begins with a fellow's will;
And it's all in the state of mind.

"And ultimately she triumphs, of course; how could it be otherwise, when she will not stop short of her goal?

"If you could go with her into her burrow, you would find it radically different from the shallow wells of the Hairys' and Yellow-wings'. The entrance slopes back six inches or more, and then makes a sharp turn to the right uniting with a passage that runs back six or eight inches farther, and terminates in a little globular cell, just large enough to accommodate the dearly-purchased cicada. From the main hall other passages lead off here and yonder, each one being supplied with a storage cell at the end. One cicada for a male child, two for a female, is her usual rule. And Mrs. Say is no slacker! So long as there are cicadas to be found humming in the tree tops, just so long she works unceasingly at lessening their number. Afterwards life apparently loses all zest; her mission is ended, and she loiters about in a dazed sort of way until Jack Frost kindly wipes her out of existence.

"Two other insect members of the digger clan that are interesting nerve specialists are those which prey upon two very good friends of man, the spiders and the big scavenger greenbottles,

and hence must be looked upon rather in the light of enemies, since what harms our friends harms us. The Bembexes, or fly-hunters, depart from the usual methods of their clan in that they kill their prey outright instead of paralyzing it. Moreover, these little people do not fit up their cells and leave matters to Fate as do the others of their clan. They cannot do this, considering the nature of their prey. A fly is a frail thing, and a preserved fly an article not to be considered. It would be merely as dust and ashes. The Bembex baby hatches in twenty-four hours, and shortly thereafter the little mother appears with a nice, juicy greenbottle, fresh from the preparation of its own ghastly tables. And she keeps this up as best she may during the two weeks it takes the little grub to grow up. Naturally, toward the end of this period, the mother grows quite frazzled and overworked. For the appetite of each baby is boundless. Fabre reports a total of eighty-two flies having been brought in by one energetic provider for the sustenance of her ravenous offspring. Like the home of the Says, the Bembexes' is a palatial affair. The entrance is as broad as one's finger, and runs back from eight to twelve inches in length, where it terminates in a room as large as a bantam's egg.

"The spider-loving wasp mentioned is the familiar mud-dauber, whose plastered

mud cells decorate our porches, the eaves of our buildings, and often even the rooms of our home. I fancy you know all about his family affairs; if not you can easily learn, as he is quite neighborly inclined."

AN INSECT THAT PRAYS FOR FOOD

"HERE'S a queer Dick!" said Tommy, one day.

It was indeed an odd six-legged creature, such as they had never seen before. It had a long slender graceful body, with a thorax nearly half the length of its abdomen. There were two pairs of wings, and the head was a funny, triangular shape, with large glossy eyes, so comically staring, that when the thing turned its neck and glanced back over its shoulder, as readily as you or I could do, it was positively uncanny. There were three pairs of legs, and the odd part about them was that the front pair were several times longer than the others and much stouter and stronger. When Max put out an inquiring finger toward the creature up came the front legs in a jiffy, and were clasped like pious hands above the insect's head.

"Do look!" cried Alice. "He is praying you not to hurt him! I never heard of the like. What is he called?"

"The praying mantis," Tommy informed, "but he is not one-half so pious and innocent as he seems. Let's put him outside, and keep an eye on him for a while."

Forthwith, the mantis was gently deposited in a clump of salvia, just outside the porch, and the young folks mounted guard. They had not long to wait for real developments. Almost on the instant a fuzzy caterpillar crawled toward the mantis, and up came the praying arms.

"You big booby!" ejaculated Max disgustedly, "afraid of a harmless, creeping thing like that! You could sweep it off the bush with one stroke of your pious hands! Atta boy, now, sic 'em!"

But the mantis was not to be heartened. He remained utterly motionless, with pious hands upraised, and the caterpillar came sedately on until within an inch or two of the poised creature, when it seemed suddenly to sense his presence. Instantly the worm's head came up with a start, and then it made a quick movement as though to tack and whirl about. But before it could do so, down came the long arms of the mantis, settling strongly about it. No matter how the caterpillar wriggled and squirmed it could not escape, and its end was soon evident.

"Oh-h!" Alice shuddered excitedly, "the creature is a fraud. He was not praying at all! Did you notice the terribly sharp hooks on the inside of his arms? Small wonder that he held them upraised; he could the better harpoon his

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PORTRAIT OF A PRAYING MANTIS

victim. Praying mantis, forsooth! *Preying* mantis, I'll say he is!"

"Some folks call him the soothsayer," Tommy informed. "Others name him the rearhorse, and in the far South they term him the mule-killer, from the mistaken notion that the brown juice he throws out is death to mules. But no name is really quite so appropriate as that of the praying mantis, irreligious though he is. The habit of 'prayer' is born with the baby mantids. Uncle John says he has seen a whole drove of them suddenly stop and thrust aloft their front legs in such perfect unison that they might have been a band of Mohammedans at noontime.

"Baby mantids are cute little chaps. I saw some this spring. Uncle John and I happened to chance upon one of their egg-cases at just the right moment. It was as queer a relic as ever I hope to see; looked just like a small one-inch length of braided gelatine, with a tiny egg hidden in each fold. The eggs all stood on end, tipping slightly toward the center of the braid, and I should say there were forty in the lot. Something about their character warned Uncle John of what was about to take place, and he suggested that we watch them a moment. And such doings! All at once a light yellowish-brown creature burst out of an egg on the end of the braid, and his appearance seemed to electrify the bunch. For in

than that he should serve as a meal for his harried wife, whose own days, too, are numbered? By the way, somebody says that if there were only enough praying mantids in the country, they might eat all the other insects and finish by eating one another, thus leaving to us a bugless world! Small chance is there of this, however, for the mantids have enemies of their own, one of the worst being a certain species of small chalcis-fly, which lays her eggs in the gelatine braids and brings off her own babies on the nourishing mantid eggs."

LOYAL LITTLE LANCE-BEARERS

Early one morning, Uncle John startled the household by a loud, merrily whistled reveille, putting such great emphasis on the "Roll out! R-oo-ll out!" that the children knew full well he had something of unusual interest to show them, and came on the run, scrambling into necessary garments like firemen en route under urgent summons.

It was a breathless group that soon stood assembled on the great screened porch, which was the family living-room in summer, and stared in dubious, unbounded amazement at what Uncle John introduced as "the only real live music box and panorama in existence." It was being established in plain view just outside against the ivy-clad stone wall of the well house, and it was no more nor less than a common wooden box, about twelve by eighteen inches, with a glass top, and a small round hole bored in one end. Inside was something that greatly resembled a mouse nest, and it is safe to say that Tommy was the only one of the witnesses who understood what was doing in the least, when Uncle John produced a corked bottle from his pocket, and, lifting the lid of the

box, poured in some three or four limp, lifeless-looking bumblebees which had been imprisoned in the bottle.

"Whoopee, Uncle John," the boy cried delightedly. "Where'd-yu get 'em?"

"Slipped in and chloroformed the lot, just like any common house thug," was the grinning reply. "Found the nest yesterday in a crevice behind the door in the tool shed. It originally belonged to Madam Gray Mouse."

"And how soon will they 'come out of it'?" demanded Tommy, eager-eyed.

"An hour or two. There is plenty of food in the box. We will keep them shut in for a few days, until they get used to their new quarters," and Uncle John plugged up the hole in the box with the cork from the bottle.

"*What!* Do you mean that is a bumblebees' nest?" ejaculated Alice, horrified. "Why, we shall all be in danger of our lives every time we step outside! Take them away, Uncle John, do, *please!* I'm horribly afraid of bumblebees. Don't you remember how terribly I got stung once, when that wretched little Beals boy was going to treat his sister and me to bumblebee honey?"

"That was different," assured Uncle John, soberly enough, though his eyes twinkled merrily at the recollection of that bygone episode, which

had been funny enough to all but the immediate participants. "You were carrying war into the enemies' quarters—pillaging their homes. Can you blame them for springing to the defense? Bumblebees are sworn to knighthood on reaching their majority, and are loyal to the heart's core. Every bumblebee in the colony belongs to the standing army, and is provided with a lance that is staunch and true. Because the countless generations of boys, mice, and bears have been what they are, bumblebees have been forced to take up fighting as a second nature. In times of dire need the whole colony, from the royal household down to the busy little nurses and the least member of the scullery force, volunteers for war, and all who have ever contested with them know how valiant they are. All, too, will testify that bumblebees themselves never start a fight. If you don't bother them, they will not bother you. Moreover, once you get interested in the busy routine of their daily affairs, you will not only forget your fear of them, but pick up many useful little sidelights which will be helpful in meeting the tasks Life sets for you. This last is the reason I left my nice comfortable bed an hour early this morning to fashion this box, and trap the bumblebee queen and her faithful retinue!"

"Show us their spear, can't you, Uncle John,

while they're safe?" begged Max, pushing to the front.

"Not very easily," was the smiling rejoinder. "It is carried in a sheath, and one needs a microscope for it. But I can describe it to you faithfully enough. It is made of two slender shafts, about one-half an inch in length, tied tightly together and forming a keen point sharper than the sharpest needle. Each shaft is notched along the inner edge in a series of grooves which fit into the shaft opposite. When the bumblebee strikes, the muscles at the base of the shaft thrust down first one side of the shaft, then the other, and the notches hold and join. At the base of the spear are two poison sacs, which release their poison as soon as the notches come together, sending it down along a groove on each side of the shaft. This poison is severely acid in its nature, and causes intense pain and swelling, as Alice will testify. Some wise fighting instinct makes the bumblebee always strike for the face and especially for the eyes, reasoning no doubt that if it can but blind its enemy, it is fairly sure of saving its home from destruction. Moreover, the little lance-bearer does not lose its weapon, as does the honey bee, and so can strike again and again without losing its life."

"Your idea of chloroforming the little warrior is a new one to me, my son," congratulated

Grandfather. "When I was a boy, nothing tasted quite so good as bumblebee honey,—stolen sweets, you know,—and we used to lay all sorts of plans to get it. Finally we hit upon the scheme of trapping the little defenders in the water jug. It was lots of fun, but rather cruel, as I see it now. I wouldn't think of doing it again, unless I were interested in the colony from a scientific standpoint."

"Of course, Grandfather, all that is understood," admitted Tommy slyly. "But go on and tell us about it. It sounds interesting."

"It *was*," smiled Grandfather. "I see it all as though it were but yesterday. We boys used to scout around and locate the bumblebee nests and suitable barricades and lookouts in the immediate vicinity; then when we judged the signs about right, we would sally forth with our jug half filled with water. This was stealthily placed invitingly within a few feet of the nest. Lots were drawn and the unlucky individual sent out to stir up the bumblebees by threshing the nest smartly with a bough freshly cut from the nearest tree. Of course, by the time the big boomers got into motion, we were all safely hidden, and there was nothing at all unusual on which to vent their ire but the inoffensive jug. Around and over it they went, muttering vindictively and beating the air with their wings, until an answer-

ing roar was produced inside the jug. Such a challenge! Pop went one excited soldier after another into the wide mouth, and the noise they made within, gasping and spluttering, only served to draw on the others. Finally the whole golden-belted horde were safely inside, or so it seemed. We learned not to judge by appearance after our first hurried dash for the precious honey! For there was always a second relay left on guard, and a second rousing, sometimes even a third, if the colony was large, was necessary. These, too, were quickly attracted to the jug and safely held. Then the honey cells and all the treasures of the house were open to our vandal hands, and sorry as I am to admit it now, we never saw anything but the honey. This we gobbled up with relish, never even dreaming that the bumblebee secrets we passed by were even more delightful than the sweetness they had stored. It was years before I thought of looking into a bumblebee colony for the pleasure of finding out how they ran their affairs."

"And the poor bumblebees that had been enticed into the jug, Grandfather," queried Max quickly, "were they always drowned?"

"No, indeed," assured the old gentleman gladly. "We were thoughtless little animals, but not heartless. We always turned out the water promptly, and the bees, though appar-

ently half-dead, soon came to life, and made haste to establish themselves in a safer neighborhood."

"What becomes of the bumblebees in winter?" Alice wanted to know, interestedly.

"All but the young queens perish when the Frost Giants come," Uncle John replied. "Instinct tells these to hide away in some safe shelter, where they sleep secure from all storms and chills. I found one last winter in the center of a corn shock out in the field. Old rubbish piles and crevices about the buildings are the favorite sites. The young queen I have brought in probably emerged about a month ago. Just how she came to discover the abandoned home of Mrs. Gray Mouse is uncertain, but as such quarters are a favorite nesting site, it may be that she deliberately hunted until she found this ready-built home.

"First of all, of course, she gave it a thorough cleaning; for bumblebees are famous housekeepers. Then she went over the outside and made it strictly water-proof; next she laid a fine linoleum of her own manufacture on the floor at one end of her house. This linoleum, as you may see for yourselves, is composed of wax, mixed with shredded hair and bits of grass. Here in this corner specially designed for the nursery she then arranged a novel mattress of pollen mixed with

honey, both materials having been gathered from the red clover field. On the mattress were laid two or three tiny eggs, the nucleus of the fine colony she hoped soon to have flourishing.

"Three or four days passed, during which time the queen mother hurriedly added to her pollen and honey mattress and laid more eggs, and then, as she roused to go about her labors one morning, lo! in the place of her first eggs were some tiny little white grubs, which must have gladdened her heart mightily. For these were workers, and full well she knew what need there would be of extra hands when her other eggs began to hatch. How eagerly she supplied them with honey and bee bread! Between times they nibbled each in their own place on their luscious pollen and honey bed, and shortly, when they had made a little hollow about them, they began to spin fine little silken cells for themselves. How proudly the queen mother viewed their industry! And as occasion offered she herself helped to strengthen these cells by reinforcing them with bits of hair, and pieces of leaves and grass mixed with wax. By and by each little grub was safely enclosed in a tight little cell over an inch long, and as thick as your thumb. You can see just what they looked like by examining other cells in the nest there, which these same workers, when they had had their short pupa sleep and emerged

to help their queen mother, assisted their younger brothers and sisters in making.

"Now, with these willing children to shoulder the bulk of the burdens, the queen needs no longer to go far afield to gather pollen and honey for the young. The workers do this gladly, and even bring in the food for the queen. She does not have to step outside the door; indeed she dare not. For faithful as are these grown-up children in all the duties of the colony, they have one serious failing. They are exceptionally fond of eggs. If the mother so much as turns her back on even her most trusted worker, the little glutton falls to and gobbles up as many eggs as it can lay hands on. So the queen must stand on constant guard lest her well-planned efforts come to naught. One would think that with all this vigilance she herself would develop an unimpeachable integrity. But alas! when, before the summer is over, she is the mother of laying queens, she is just as anxious to eat their eggs as they were to eat hers.

"By and by there will probably be fifteen or twenty laying queens in our colony here, with two or three score or more of workers. Then, as you may imagine, affairs will be decidedly interesting. Busy will be no name for the little queens on guard over their precious eggs. But there will be no danger of their coming to blows.

The culprits seem to know well enough that they are in the wrong, and whenever a pilferer is discovered she slinks away meekly enough.

"Bumblebees seem to know that their home is only a transient one. They do not store up provisions for winter, as do the honey bees. Ten days' supplies on hand in case of damp and unfavorable weather is quite sufficient to satisfy their ambition, and at best not more than a quarter of a pint of honey is ever to be found in their little jars. That it makes up in quality what it lacks in quantity every boy that ever robbed a colony knows. Nothing more delectable than bumblebee honey ever tickled any one's palate. Their honey jars show how adept the little workers are at utilizing remnants and by-products. Take a look at this one. Note that it is simply an abandoned silken pupa case, cut down, and glazed with a specially prepared wax to make it moisture proof.

"When our colony gets a little stronger, they will work on bright moonlight nights. But bumblebees are not like the honey bees, who never sleep during the working season; they take advantage of dark or cold nights to recuperate their energies. Then they show another really remarkable trait: a night watch is appointed to stand guard over the sleeping hosts. The sentinel does her duty most faithfully: all night long

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THE BUMBLEBEE VIEWED FROM BELOW

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AN INTIMATE VIEW OF HONEY-BEES

she creeps back and forth over and around the bodies of the sleepers, making sure that all is well, until the tints of dawn begin to streak the east, when she sets up a queer little trumpeting sound with her wings, quickly awakening the colony. The same bumblebee serves as watchman night after night. Should anything happen to her a new guard is appointed. But don't ask me who makes the appointments, nor who settles what bumblebees shall fill all the other positions either, for that matter. It may be that the tasks are set by lot, *eeny, meeny, miny, mo* style. But one thing seems to have been established: the large bumblebees attend to the building and mending of the nest and bringing in the provisions; the smaller ones do the inside work,—such as building up the cradles, nursing and feeding the young, and generally keeping things neat and tidy.

" One careful observer watched the nurse bees mixing up rations for the babies. He found them dipping first into the honey stores, then into the pollen, and mixing up a special little food of the two in another jar. Then, preceded by maids who carefully made an opening into each cradle, the nurses took the filled ' bottles,' which they doubtless carried concealed about their persons, and gently lifting the helpless little grubs, proceeded to feed them with the brownish fluid which

they had concocted. The babies accepted it eagerly. Whether both the males and the females were fed with the same mixture could not be decided; however, it is very probable that they were not; for in the insect world, you know, the kind and quality of the food has now come to be regarded as the leading factor in determining the kind of individual that will be reared.

"As winter approaches, the new queens that come to maturity leave the nest and seek a mate. After which, the queens crawl away into some snug place for the winter, as I have said. Instinct tells them that it would not be safe to go to sleep in their nests on the ground; these have long been charted by all the mice in the vicinity. As soon as Jack Frost numbs the valiant little defenders, there will be a grand raid, and bumblebees, babies, eggs, honey and all will disappear down the greedy little red throats.

"One thing which the naturalists are eager to learn about is the number and kind of parasites and guest bees which are harbored in bumblebee colonies. If you folks keep your eyes open you may have something worth while to relate. There is one guest bee in particular which looks so much like its hosts that it will require careful observation to spot it. These bees are so lazy that the industrious bumblebees object strenuously to receiving them, but some innate sense of

hospitality forbids their turning an intruder away with violence, and so clever and nice mannered is the guest, and so absolutely unable to take a hint, that once it is safely domiciled under a roof, it never leaves, and apparently its presence is shortly accepted with resignation, if not with cordiality. Time was when people believed that the offspring of these bald-faced spongers eventually starved out the children of the real owners of the colony; but now we know that this is not true.

"There are numerous species of bumblebees, the family insignia being a thick hairy body, with the hairs frequently arranged in colored bands. They are found in all parts of the world from the equator to the far northern limits of vegetation, but are more common in temperate climates. Originally no bumblebees were found in Australia or New Zealand, but they have been imported and acclimatized for a particular service which these little warriors render to mankind. I think perhaps you know about this," Uncle John paused, smiling inquiringly as he noted the eager expressions about him.

"Yes, indeed," chimed Max. "No one can grow red clover without bumblebees. And red clover is the farmer's most prized crop, not only because of its value for cattle feed, but as a cover crop for making over worn-out land."

"Right you are, my boy," endorsed Uncle John. "Clover bloom is so constructed that it cannot make seed if left to itself. The pollen grows near the top of the little tubular blossom, while the pistil is near the bottom, under a fold in the flower. As you know, the pollen grains must reach the pistil or no seed will be formed. So the clover prepares a jar of honey to offer in payment to the insect that will do this work for her. There are always two applicants for the job: the butterflies and the bumblebees. But the butterflies are indifferent workers; their long slender tongues sip up the nectar, barely touching the waiting pollen, and some bands nip holes at the base of the honey tube, thus leaving the plant a prey to the gall-making beetle and the rascally cutworm. Small wonder, then, that the clover prefers the honest, thoroughgoing bumblebee, and as for that belted leisurely boomer, how he does love the clover's precious nectar!"

"I know a verse about that, Uncle John," said Ruth, and, scarcely waiting for a nod of permission, she finished the talk by reciting happily:

Though the bumblebee's a rover,
  Seeking ever for sweetness new,
To the little Lady Clover
  He in his heart of hearts is true.
"Sweet! Sweet! Sweet! Sweet!"
  He hums it over and over.

"Where in the wide world will you meet
With the likes of my Lady Clover?
Pink she is, white she is,
A little thing of delight she is!
Sweet! Sweet! Sweet! Sweet!"
He hums as he sways above her,
"Nowhere at all do I ever meet
With the like of my Lady Clover."

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